THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXV. No. 1675.] LONDON, JUNE 18, 1895. [47TH YEAR. PRICE 6d.

JAMES OAKES & Co.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,
Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers, and rendering leakage impossible.

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Best Absorbent of Sulphuretted Hydrogen, &c.
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PRICES, &C., ON APPLICATION.

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LIMITED.
LANEMARK CANNEL
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NEW CUMNOCK, N.B.
Shipping Ports: All the principal Scotch Ports.

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Prices and Analysis of all the Scotch Cannels on Application.

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HOPE CHEMICAL WORKS, HACKNEY WICK, LONDON, N.E.,
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Importers of Petroleum for Carburetting Water Gas, or for Manufacturing Oil Gas. Distillers of Petroleum Ether and Naphtha for clearing the pipes of Naphthaline, &c.
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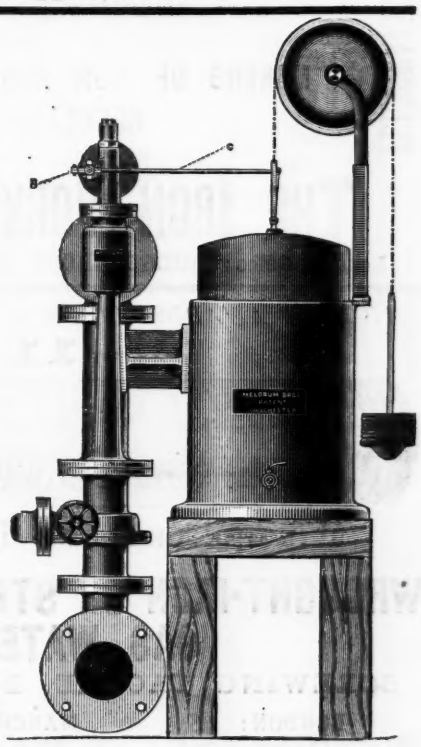
ABSOLUTELY AUTOMATIC.
REQUIRES NO ATTENTION WHATEVER.
Guaranteed perfectly steady Gauge, no matter how Steam Pressure may vary.
— HIGHEST REFERENCES GIVEN. —



MELDRUM BROS., Atlantic Works, City Road,
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Telegrams: "MELDRUM, MANCHESTER." National Telephone: No. 1674.

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The principle is the same as in the horizontal one, which has now been before the profession for a number of years, and where adopted is giving unqualified satisfaction.

The Washer is entirely automatic in its action, and does not therefore need any motive power—an advantage which will be apparent to all.

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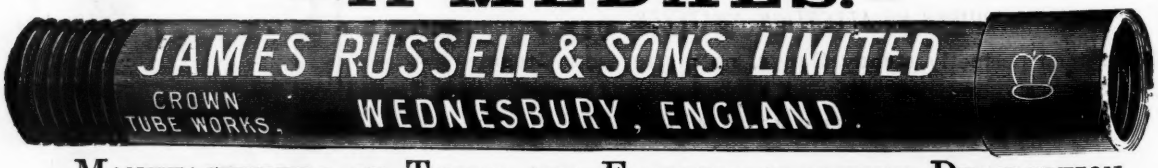

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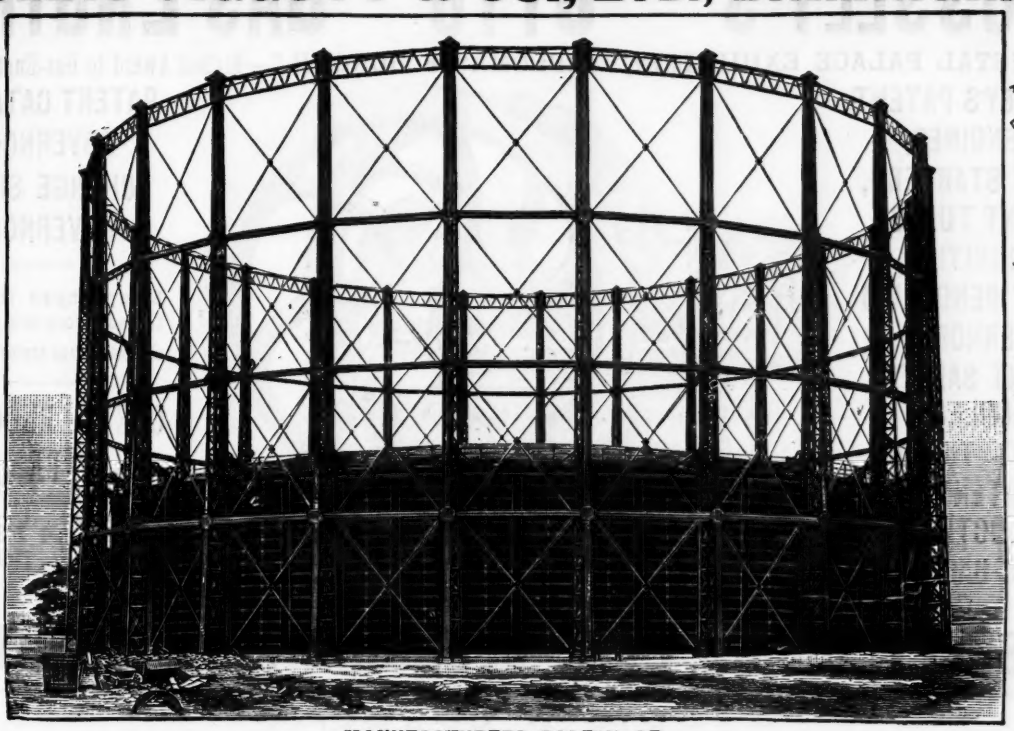

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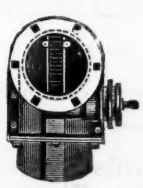

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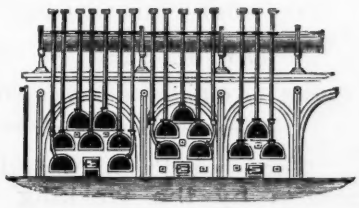

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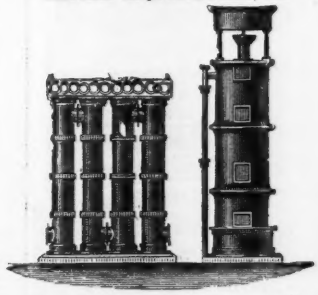

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for working Purifiers,

Also Bye-Pass & Stop Valve

PURIFIERS with Planed Joints,

HAND and HYDRAULIC LIFTING GEAR, CAST-IRON MAINS and SPECIALS.

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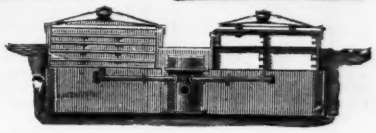

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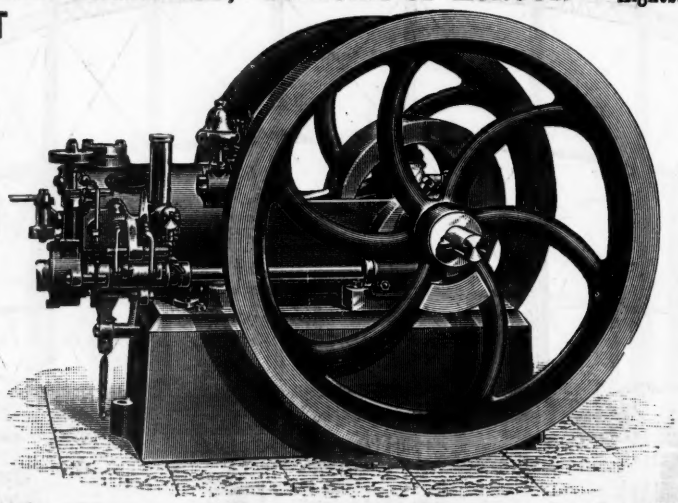

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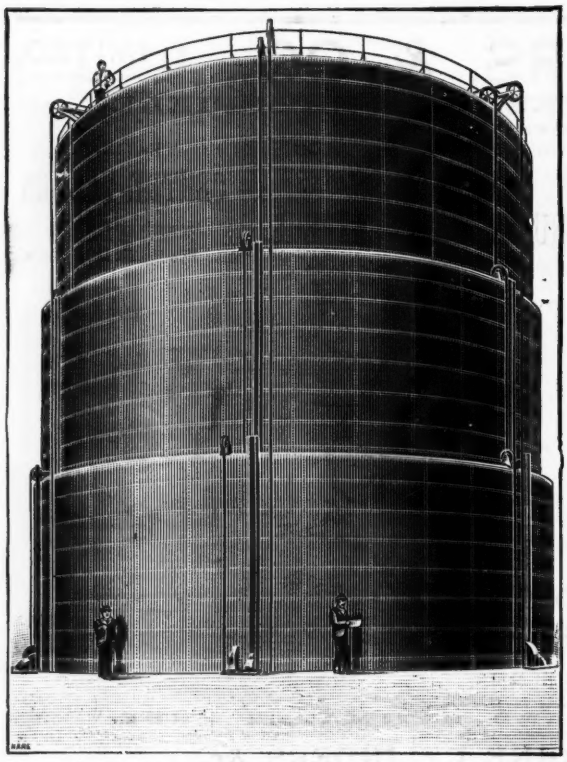

From Photo. of Three-Lift Roped Holder, 50 feet diameter by 18 feet deep each Lift. Erected at Sligo, 1894.

Pease's Patent Roped Gasholders

THESE HOLDERS HAVE WORKED SUCCESSFULLY UNDER EVERY TEST TO WHICH THEY HAVE BEEN SUBJECTED SINCE 1889.

MAY BE SEEN AT MANY PLACES.

Send for Catalogue if requiring increased Storage.

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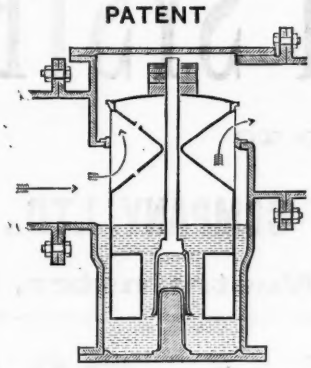
PATENT



AUTOMATIC PRESSURE REDUCER.

STATION METER GRECIAN DESIGN.

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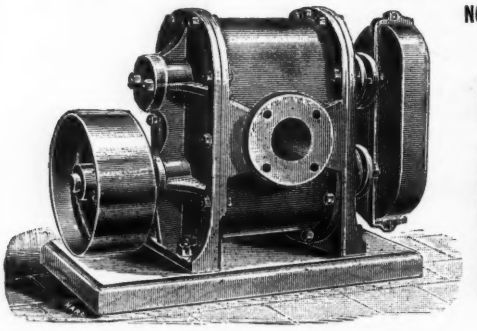
DRUM PUMP AND GAS EXHAUSTER.

The Pump of the future for quickly and economically moving large bodies of Water, Semi-Fluids, &c.

The force of the Piston Pump with the capacity of the Centrifugal combined.

NO SLIDES OR FRICTIONAL WORKING PARTS.



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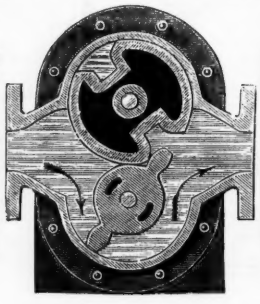

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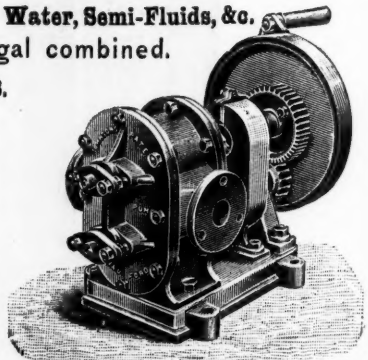

As supplied to H.R.H. the Prince of Wales for Pumping Gas Liquor at his Sandringham Gas-Works.

DRUM ENGINEERING COMPANY,

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IMPROVEMENTS IN STREET LIGHTING.
HIGHEST EFFICIENCY WITH GREATEST ECONOMY.

LIGHTING AUTHORITIES, GAS ENGINEERS, & GAS MANAGERS

Are invited to inspect the

INCANDESCENT GAS-LIGHT

Which has now been successfully adapted to the purposes of

STREET LIGHTING,

THE DIFFICULTIES CAUSED BY VIBRATION HAVING BEEN OVERCOME BY THE USE OF A SPECIAL BURNER, WHICH GIVES HIGHLY SATISFACTORY RESULTS.

Two forms of Burners are specially recommended for Street Lighting.

The "C" BURNER,

Giving a Light of 60 Candles, with a Consumption of 3½ Cubic Feet of Gas an Hour.

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Giving a Light of 25 to 30 Candles, with a Consumption of 2¼ Feet of Gas an Hour.

This System of Lighting meets the Requirements of all the Lighting Authorities in those Districts where it is desired to effect an Improvement in Street Lighting, without any increase of expenditure.

THE INCANDESCENT GAS-LIGHT has been tried with most satisfactory results for Street Lighting purposes in many Towns throughout the United Kingdom.

The Lighting Engineer of the Kensington Vestry, in a report dated the 14th of May, 1895, addressed the Works and Sanitary Committee as follows:—

(1) During the months of January, February, and March, 1895, 31 Incandescent Gas-Lamps were in use for an average period of 1167·89 hours.

The estimated quantity of gas that would have been consumed by the 10-feet flat-flame burner was 11,678 cubic feet. The actual quantity of gas used by the Incandescent Gas-Light Company's Burners, as recorded by the meters, was 4415 cubic feet.

After allowing for the extra cost of up-keep, the gain to the Vestry by the use of these burners was £20 3s. 4¾d., and a large increase in the Illumination of the Street.

(2) The illuminating power given by the Incandescent Gas-Burners, consuming 3·78 cubic feet of gas per hour, was found to be equal to 60 candles. That given by the flat-flame burners, consuming 10 cubic feet of gas per hour, was 26 candles.

The lanterns fitted with Incandescent Burners only require cleaning 9 times in 90 days, as compared with 26 times' cleaning in the same period required by the lanterns fitted with flat-flame burners.

The net result therefore appears to be that, by the use of the Incandescent Gas-Light System, the saving effected is over 50s. per annum per lamp, and at the same time more than double the light is obtained.

It must be noted, however, that these results were obtained with the ordinary burners, and not with the improved burners with the anti-vibration springs. With the latter, the expense of up-keep would be materially reduced, and the saving consequently increased.

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THE FIRST PRACTICAL AUTOMATIC GAS-METER

Was Manufactured under the Patents of

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Whose present Automatic Gas-Meter is absolutely

"UNBREAKABLE, UNFAKEABLE," AND THE BEST IN THE MARKET.

CAN BE ORDERED TO TAKE EITHER PENNIES OR SHILLINGS.

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THE

MAXIM PATENT CARBURETTOR

FOR ENRICHING GAS IN BULK.

Over 50 Maxim Patent Carburettors have now been fixed, capable of enriching

650,000,000

CUBIC FEET OF GAS PER DAY.

Among the Companies supplied are The Gaslight and Coke Company, the South Metropolitan Gas Company, Birmingham Corporation, Manchester Corporation, Rochdale Corporation, Bristol Gas Company, and many other Works, both large and small, where they have been working in some instances for the past **FOUR YEARS.**

More Gas and saleable Coke per ton of Coal Carbonized is produced; saving Capital, Labour, Fuel, Wear and Tear, &c.

The Enrichment is **INSTANTANEOUS** and **PERMANENT.**

The Carburettor is inexpensive, easily fixed, and entirely supersedes the use of Cannel.

SOLE AGENTS FOR REDWOOD & CLOWES' INFLAMMABLE VAPOUR & GAS DETECTORS.

FOR PRICES AND FULL PARTICULARS, APPLY TO

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Dealers in Carburine and all other Naphthas for the Enrichment of Gas.

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Central Works & Offices, Commercial Rd.,
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CONTRACTORS FOR THE ERECTION OF COMPLETE GAS-WORKS.

SPECIALITIES.

ENGINEERING—Gasholders and all kinds of Wrought Steel and Iron.

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GAS-FITTINGS—Designed and made in endless variety. Special Patterns for the new Incandescent Burners.

Gas Companies supplied at short notice with any quantity of suitable Pendants and Brackets for the Automatic Business.

Great Economy effected by new Labour-Saving Machinery recently laid down in all Departments. Inspection Invited.

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ESTABLISHED 30 YEARS.

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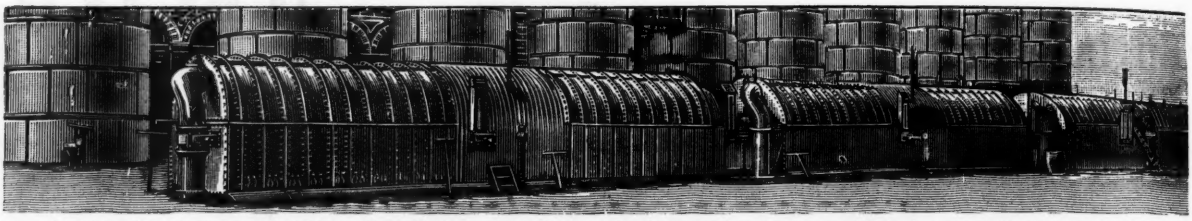
PATENT "STANDARD" WASHER-SCRUBBER

☛ **492** of these Machines (capable of dealing with **472,540,000** cubic feet of Gas daily) in use, which fact is given as evidence of this apparatus being the Most Efficient of any in the Market for the extraction of Ammonia, Carbonic Acid, and Sulphuretted Hydrogen from Coal Gas.



View of SIX PATENT "STANDARD" WASHER-SCRUBBERS, erected at the Beckton Station of The Gaslight and Coke Company (the Engines driving same being under Galvanized Iron Covers). This Company have 30 of these Machines in use. They are also in operation at a great number of Gas and other Works in this Country and Abroad.

MARSHALL'S PATENT BATTERY CONDENSER & SCRUBBER.

This apparatus being made in sections, the capacity can be easily and cheaply made proportionate to increased make of Gas. Other advantages are: Large and effective cooling area on small ground space, slow speed, no repairs required, high strength liquor obtained, &c.

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Extracts practically all the Tar without choking up, and gives minimum back-pressure.

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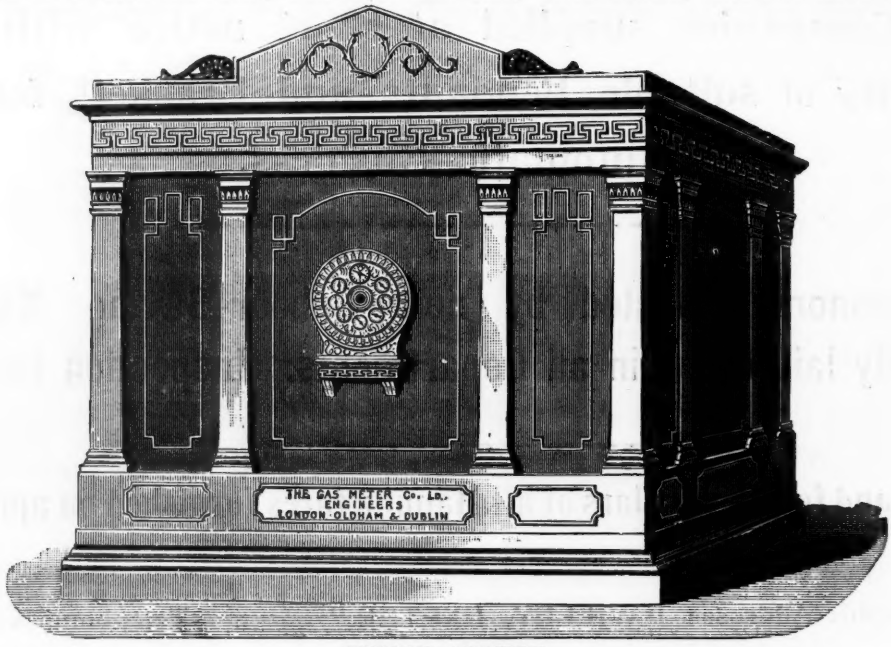
MANUFACTURERS OF

WET AND DRY GAS-METERS, STATION METERS, GOVERNORS, GAS APPARATUS, ETC.

SQUARE STATION METERS WITH PLANED JOINTS.



STATION METERS IN CYLINDRICAL CASES.

DESIGN No. 2 PATTERN.

STATION METERS MADE AT THE COMPANY'S WORKS, OLDHAM, LATE WEST & GREGSON. Established 1830.

For Prices and Particulars apply to

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London Office: 10, FINSBURY SQUARE.

PURIFIERS with Planed Joints.

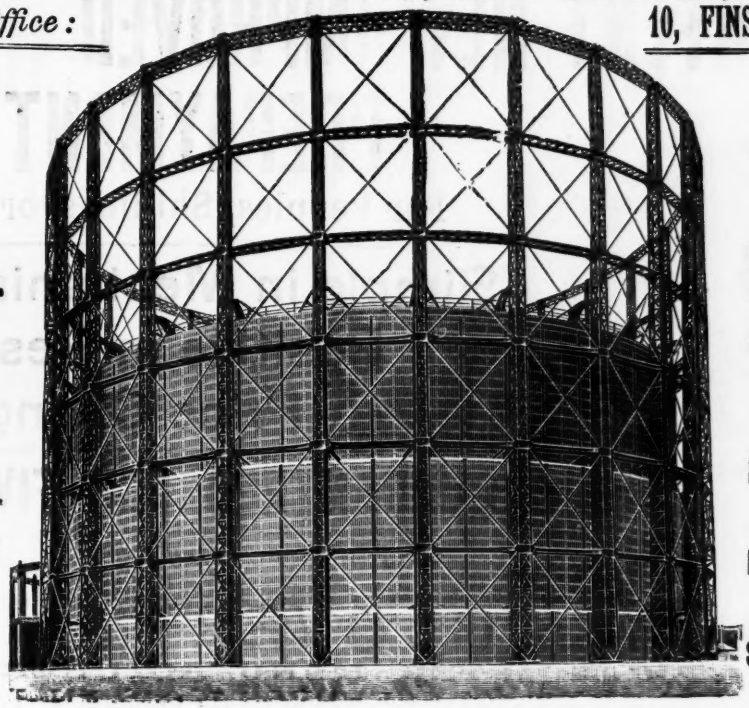
TOWER SCRUBBERS.

WECK'S PATENT CENTRE-VALVE.

CONDENSERS.

TAR PLANT.

SULPHATE OF AMMONIA PLANT.



Eight Million Cubic Feet Gasholder at Beckton, London.

WASHERS.

WASHER-SCRUBBERS.

CLAUS' SULPHUR-RECOVERY PLANT.

CENTRE & FOUR-WAY VALVES.

CRIPPS' HYDRAULIC MAIN VALVE.

RETORT-MOUTHPIECES.

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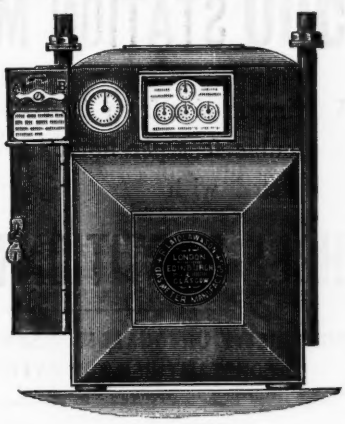

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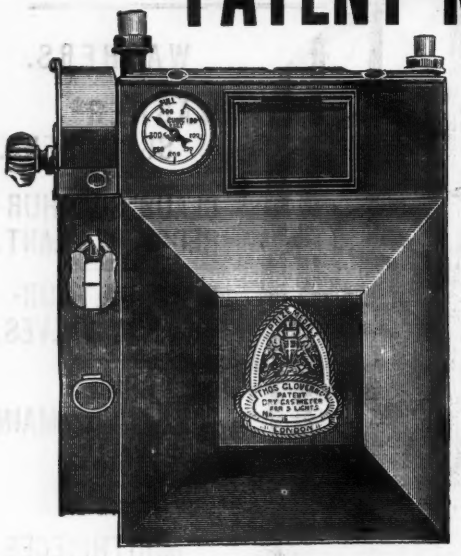

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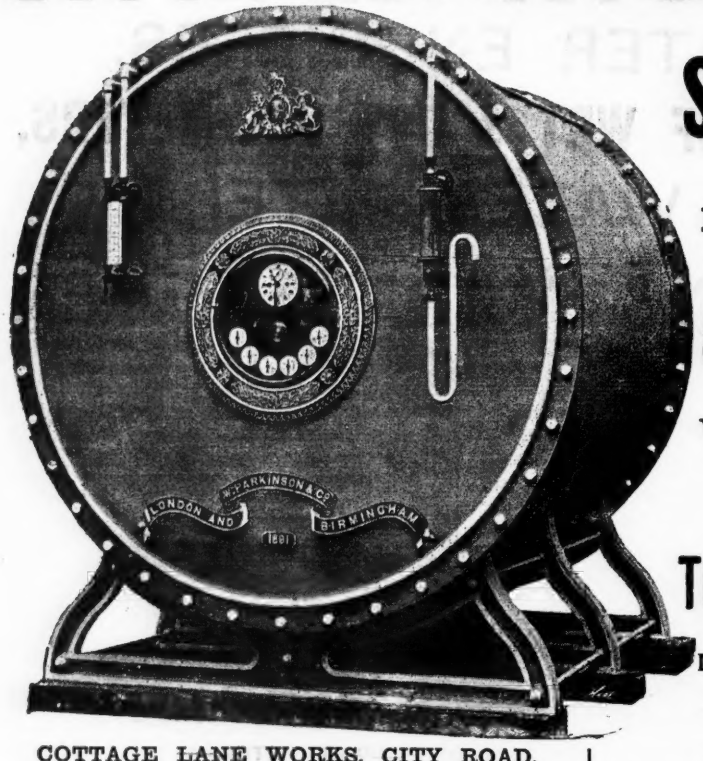

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EDITORIAL NOTES.

The Meeting of The Gas Institute.

THE meeting of the Incorporated Gas Institute for 1895 has been held; and the proceedings will be found duly reported elsewhere. In discussing the impression created by them as a whole, it is necessary to make allowance for the accidental influences of the place of meeting, the weather, and the climate of the past winter. These three influences contributed to bring together a large assembly of members and friends of the Institute, to some of whom the quality ot the technical business transacted was not a primary consideration. The winter was so severe, that everybody wanted to get away to some pleasant place on the first opportunity. The weather has been so fine of late, that people have been tempted to travel far; and nobody needs much inducement to take a week's holiday in Edinburgh, with the Clyde and the Highlands as it were "over the way." Hence it is not to be wondered at that the number of members and of visitors at the Institute meeting this year appeared to be exceptionally large. The proportion of ladies attending was for this reason unusually strong. In short, the Edinburgh meeting of the Institute for 1895 would rank very high in the records of the association in respect of the pleasure, or popular, side of the proceedings. The municipal authorities of Edinburgh and Leith made the Institute welcome; and the officials of the Institute discharged their task commendably. Mr. R. Mitchell, the President, proved himself fully equal to the performance of the duties of the position. His Inaugural Address is discussed elsewhere; so need not be further alluded to here. His management of the meetings, it must be admitted, was commendable. The Secretary, Mr. F. G. Burfield, is always efficient.

So far as the technical transactions of the meeting are concerned, it is to be feared that, with a few notable exceptions, they will read somewhat thin and unsatisfying. Professor Lewes is a host in himself; and his contributions alone would have rendered the meeting worth the holding. Mr. Lewis T. Wright, again, is a fund of sterling information respecting points of gas manufacturing. But besides these, no other contributor to the proceedings had anything of great importance to bring forward; and the discussions were even poorer than the papers. More than one of the latter should not have been accepted by the Council at all in the form in which it appeared; and indications were not lacking of the emptiness of the requirement that all contributions should be submitted to, and read by, the Council. It is notoriously difficult for any technical society to get plenty of good papers; but if the members of the Institute hold the organization in such regard as they profess in complimentary speeches, moving votes of thanks, and so forth, they will see to it that future meetings are not so dependent for technical interest upon the arrangements which the Council may be able to make with professional lecturers.

With regard to one subject, we desire to engage the particular attention of every member of the gas engineering profession, whether in sympathy, fellowship, or otherwise with The Gas Institute. This is the present condition and the prospects of the Benevolent Fund. It is unnecessary to say anything respecting the origin and purposes of this fund, which, although remaining ostensibly an appanage of the Institute after the "disruption," constitutes the sole charitable effort of the organized members of an honourable and not impecunious profession. It is, in effect, the one patent bond of union for fraternal objects between those who have remained in, and those who have quitted, the Institute. Now, it would be a shameful thing if aught that has occurred in regard to strictly Institute matters should have the effect of crippling the operations and prejudicing the stability of the Benevolent Fund. Yet it is notorious that, unless an improvement speedily sets in, the very existence of the fund cannot be far prolonged. If no other course can be relied upon to revive interest in this beneficent agency, we would suggest the propriety of holding a conference on the subject between the heads of the Institute and the Institution of Gas Engineers, with a view to settling matters in this regard upon a more satisfactory footing. The question is urgent; and it is greatly to be desired that no time should be lost in arriving at an understanding, creditable to the profession in general, with reference to the furthering of the objects which the present Benevolent Fund was founded to promote.

The Improvement of Gas Lighting in Scotland.

VISITORS to Edinburgh and the neighbouring towns, in connection with The Gas Institute meeting, could not fail to notice the change that has been brought about in the lighting of the principal centres of business, in even small places, by the general introduction of incandescent gas-burners. To some extent, this improvement has probably been due to the appearance in the main streets of the Scottish capital of the electric lights, which are employed on rather a liberal scale, and have the effect of rendering more conspicuous the gloom of those regions where the old-fashioned small flat-flame gas-burners are retained. Edinburgh, for all the high photometric value of its gas, has hitherto been one of the worst-lighted cities in Europe; but, at the rate at which an improvement in this regard has set in, it will soon lose this reproach. We mention the matter here only for the sake of the bearing of the new system of lighting upon the vexed question of the best and most economical grade of illuminating gas that can be supplied in British towns. To all intents and purposes, as much light can be got out of ordinary 15 or 16 candle coal gas by the use of the incandescent system, as can be derived in the same way from the richest and costliest cannel gas. So that it is hardly too much to say that, for places where no other consideration than lighting efficiency determines the issue, the days of highly carburetted gas are numbered. It may be objected that there are many places in a house of business or a private dwelling where lights are required, for which the, as yet, expensive incandescent lamp is not necessary, or even desirable. But to this it may be answered that for such uses a high-priced gas is equally uncalled for. Moreover, the incandescent system is bound to become cheaper rather than dearer as time goes on. What we see in progress in Edinburgh and elsewhere now is only a preparation for what is to come later on. Professor Ivison Macadam "let the cat out of the bag" when he remarked at The Gas Institute meeting that the reason for Edinburgh still having cannel gas is because there is a lot of cannel coal to be sold. The observation was semi-jocular, and need not be taken for more than it is worth. The more serious argument for the persistence of dear and nominally high-quality gas in Edinburgh is that the people have long been habituated to it, and would be inconvenienced by a sweeping change. But the experience of Glasgow goes to prove that a reform in this respect is not impossible. It is certain that the Corporations of Edinburgh and Leith have it in their power to sanction what a Gas Company would find infinite difficulty in getting accepted. The popularization of gas for cooking, heating, and motive power will gradually, but irresistibly, work in the same direction as the incandescent burner, in spreading the conviction that traditional photometry does not say the last word for the true illuminating value of coal gas; and we fully expect to record at no distant date a resolution in regard to the gas supply of Edinburgh and Leith which will put the population of the district in possession of a generally suitable means of lighting and heating at a truly popular price.

The Board of Trade and Gas Undertakings.

IN another column we publish a statement of some interest with reference to the dealings of the Board of Trade with certain proposed Provisional Orders applied for under the Gas and Water Works Facilities Act, in which it was a question whether the consent of the Local Authorities concerned should be dispensed with. This is a point of considerable importance; and it is satisfactory to learn that in no case was the unreasonable opposition of an authority held as sufficient justification for denying to the applicants the facilities asked for. The strongest case in the list is that of the Newark Order, which was applied for by a statutory Gas Company who had need of more capital, and desired to extend the area of their operations. This very natural request was objected to by various interested parties, for several reasons. Most of the objections were met, and the opposition in general pacified. But the Corporation of Newark did not want the Order to be granted upon any terms, because they wished to have in their own hands the power to light the borough, and were prepared to purchase the undertaking in terms described as "fair"—probably meaning terms to which the present proprietors would give another description. The Corporation urged that a clause should be inserted in the Order, giving them power to purchase the undertaking compulsorily at any time within two years after the passing of the Order. Major Marindin held the inquiry into the matter, and came to the conclusion that, inasmuch as there is no precedent in existence for the insertion of such a clause in any Gas Bill or Provisional Order, except by agreement beforehand between the parties, there should be no such precedent created in the case of Newark. This recommendation has been adopted by the Board of Trade, after careful consideration of the point; and accordingly the Order has been granted in the Corporation's despite. The issue might have been different if the Newark Company had not been actually in possession of statutory protection. But they are already fully authorized to carry on their lawful business in a proper manner; and it is not for a Local Authority to hinder the natural development of this business for their own particular ends. The grasping proclivity of the Corporation nevertheless gave the Company and the Board of Trade some trouble; and the lesson of the incident should not be ignored by the considerable number of Gas and Water Companies who are even less protected than the Newark concern. Recent legislation has aroused in many local authorities a new sense of their importance, and an increased desire to enhance it by engaging in work which they had formerly been well content to leave alone; and the directors of public supply companies, who are trustees for the share and debenture holders, incur a heavy and a superfluous responsibility if they neglect the means of protection provided by the law for their undertakings. The Board of Trade may be depended upon to "see fair" between gas companies and local authorities if set in motion in the proper manner; and it is not the fault of the Department that so many gas undertakings yet remain without legislative protection.

Corporation Gas Finance.

THE small town of Neath has a public gas undertaking, which is doing very well under the enlightened policy followed consistently during the past twelve years by the Gas Committee—of considering the interest of the consumers first, and afterwards of reducing the capital account. We published last week some particulars as to the present position of the Neath undertaking, from which it will be seen that the Town Council upheld the Committee in their policy, notwithstanding the opposition of the Mayor, who seemed to think the gas cheap enough because it was not so dear as it was many years ago. We mention the instance of Neath here because it illustrates the great maxim that no town is too small to have a right gas policy. Here is a district, the population of which does not grow at anything like the rate of many more thriving places. Yet, by looking after the consumers, the Gas Committee have managed to double their output within the last twelve years, and pay off £32,000 of the original capital debt of close upon £60,000. Now they are again reducing the price of gas by 2d. per 1000 cubic feet. Like many other corporation gas undertakings, that of Neath has no working capital. It is dependent upon a bankers' overdraft for tiding over the gaps between times of payment and receipt. The Gas Committee have to live from hand to mouth, in a fashion that would be impossible in the case of a private trader; and all because, for some reason unexplained, the Board of Trade would not let them have (under the terms of their last Provisional Order) permission to raise a sum of money for working capital except under the condition that it should be repaid within ten years. We commend the example of Neath, so far as its gas policy is concerned, to the study of some larger towns, which—under the mistaken notion of recognizing the claims of the ratepayers—persist in frittering away their surplus gas profits in aid of the rates from year to year. To reduce the price of gas, and after this to lighten the capital account, should be the two fundamental points of the policy of all corporation gas departments. Rates continually tend to increase with the passing years; and it is a mistaken kindness to conceal from the ratepayers of the present, by means of an unearned subsidy from the gas profits, or from any other adventitious source, the extent of the burdens which are being piled upon them. It is far wiser to let the facts be kept in the foreground, and apply anything that can be spared from a purpose so likely to benefit a community as the reduction

of the price charged for gas, to the equally beneficial purpose of clearing off the debt upon the gas-works. Then whatever other burdens the future may bring upon the ratepayer, he will not be required to pay the old charge for establishing the gas-works. The last is the point. We do not wish to argue for making the present generation bear all the cost of wiping off the capital of its gas undertakings. This cannot in effect be done so long as the business continues to expand. Fresh capital must be constantly raised and expended, so as to meet the requirements of new business. But we do think that both corporations owning gas-works and companies as well, might address themselves more systematically to the extinction of the old dead capital burden attributable to the early vicissitudes of the industry. In other words, the capital of gas undertakings ought more nearly to approximate to the structural value of the works and land; and it is ever arguable that it should be brought down to the land and "old-iron" valuation—not violently, of course, but by what would be an imperceptible financial operation. We should like to have this subject discussed in the pages of the JOURNAL.

The Factories and Workshops Bill as Amended.

THE House of Commons Standing Committee on Trade has been working away steadily at the Factories and Workshops Bill; and the clauses of the Bill as amended by the Committee up to the end of last month, have been printed. In the first clause, which deals with overcrowding of factories or workshops, it was originally proposed that the proportion of space allowable per head of the inmates might be modified by the Secretary of State for any period during which artificial light is needed—as the phraseology of the Bill somewhat superfluously has it, "for illuminating purposes"—by the substitution of higher figures for those inserted in the Bill. But exception is now made in favour of the electric light. This adventitious advantage conferred upon the electric light for mills and factories may materially help to establish the system of lighting in the favour of manufacturers pinched for room. Several modifications have been made in the original clauses relating to the working of self-acting machines, and to the protection of factories against fire. It is provided that, where any matter in difference is referred to arbitration under the eighth section of the Act of 1891, the arbitrators or umpire may, on the application of any of the workmen employed in the class of employment to which the arbitration relates (and on such security, if any, as may appear to the arbitrators or umpire sufficient to provide for the costs of, and consequential on, the application), appoint any person to represent the workmen or any class of them on the application; and any person so appointed shall be entitled to attend and take part in the proceedings of the arbitration—either in person or by a legal or lay representative—to such extent and in such manner as the arbitrators or umpire may direct. This is a clause which may mean a great deal, or may prove a dead letter, as circumstances determine. It may be doubted whether the Trades Unions will care for a permission to intervene in arbitrations which carries with it the possibility of being made liable for part of the expenses. They would like the first part of the business very well; but do not relish the notion of being answerable for costs. Section 82 of the principal Act, which provides penal compensation to persons injured by the neglect of employers to fence machinery, is made to extend to any death or bodily injury or injury to health, in consequence of the occupier of a factory or workshop having neglected to observe any provision of the Factory Acts or any special rule or requirement made in pursuance of the Act of 1891. The employer is somewhat protected from the possibly tremendous consequences of the latter part of this enactment by the provision that, in case of injury to health, he is not to be liable under the section unless the injury was caused solely by such neglect. It is impossible to regard such a clause as this without serious misgivings as to how it is likely to work. It looks as if it were the intention of Parliament, in inserting such a provision, to compel employers to require applicants for work to submit to a medical examination.

Mr. A. Cooke, the Manager of the Oldbury Gas-Works, has been granted an honorarium of £20 for additional services rendered during the severe frost of the past winter.

WATER AND SANITARY AFFAIRS.

THE position of the London Water Transfer Bills has become eminently peculiar. At the sitting of the Hybrid Committee on Wednesday last, the instructions to the Arbitrators were swept out of the scheme. A pause was then allowed, in order that the County Council might consider what course they would pursue. There was reason to apprehend that, with the loss of the proposed instructions which were to govern the arbitration, the Council would decide to withdraw the Bills. When the Committee reassembled on Friday, it was found that the Council had resolved to make a further stand; adopting as an interpretation of the Committee's decision that either side would be entitled to insist upon any matters affecting the value of the undertakings being taken into consideration. According to this view, the instructions which had been expunged from the Bill—at present the one relating to the Lambeth Company—would reappear in the shape of arguments and evidence addressed to the Arbitrators at the valuation. The Companies could produce the report of the Royal Commission; and Mr. Binnie could be put forward to contradict it. Mr. Balfour Browne, arguing on this inference, stated that the promoters of the Bill "saw no difficulty in bringing up a clause in general "terms in lieu of clause 6;" this being the clause in the Lambeth Bill which contained the instructions. "General "terms" are, therefore, to take the place of specific directions. This is an ingenious way of shooting round the corner, and has the advantage of agreeing to some extent with an idea expressed by the Chairman, who, in announcing the decision of the Committee last Wednesday, said they would be willing, on consideration of the clause, to introduce, if necessary, "other general words" in addition to those which required the Arbitrators to have "regard to all the circumstances of the case;" the object of the addition being "to render it absolutely clear that "the Arbitrators are not to be precluded by any legal "objections from entertaining all the circumstances which "they may think it right to take into their consideration." Mr. Plunket, in speaking for the Committee, said they considered it "obvious," with respect to the report of the Royal Commission, "that such an important document "should be open to the consideration of the Arbitrators." We may observe, in passing, that this conclusion was not obvious to the County Council until last Friday, when Mr. Balfour Browne accepted the view entertained by the Committee.

While seeking, by a kind of flank movement, to minimize their defeat on the conditions of arbitration, the County Council are striving to steal a victory on another point. Thus it was stated by Mr. Balfour Browne that the promoters considered that the Committee accepted the proposition that "they had made out a *primâ facie* case for the "transfer of the undertakings to the County Council." The Chairman interposed by saying: "You mean subject "to what may be said on the other side." Evidently Mr. Balfour Browne was trying to get the preamble proved by a short cut. Signs of haste further appeared when the same gentleman created a surprise by stating that, in the exercise of his discretion, he forthwith closed the case for the County Council; and it would be for their opponents to show that the preamble was untrue. Time had apparently become precious to the Council. The Chairman followed with some remarks, in which he referred once more to the fact that none of the petitions against the Bill proposed the setting up of any alternative Central Authority. The omission is one to be regretted, seeing it would have been perfectly easy—as we argued on a former occasion—to suggest the formation of a Trust or Water Board to cover the whole area now subject to the Metropolitan Water Companies. As the outside Local Authorities are about to be heard—probably to-day—a way to escape the clutches of the County Council will possibly present itself. But there is one respect in which the position of the Committee seems scarcely logical. They have based their proceedings on the principle that there should be one representative public body for the management of the water supply for all London. Yet they are simply dealing with two Bills, limited to a couple of Companies south of the Thames. Mr. Pope put the question very properly on Friday, whether the transfer was to be carried out one Company at a time, or only to be authorized in the event of the Council purchasing the

Companies as a whole. The Committee have a difficult task before them; and it will require some effort to keep the inquiry from drifting into an awkward complication. With respect to the matters which may be laid before the Arbitrator, it has been explained by Mr. Plunket that this functionary will be at liberty to decide whether he shall entertain the matters submitted to him, or any of them. The subject comes under debate at the County Council to-day, on a long report from the Parliamentary Committee.

Two of the Metropolitan Water Companies—the Southwark and Vauxhall and the Grand Junction—held their half-yearly meetings last week. In each instance, there was a large extra expenditure to be met as the result of the recent frost. The Southwark and Vauxhall Company had expended as much as £10,800 up to the close of the last half-yearly account, in consequence of this extraordinary visitation; but the Directors advised the shareholders to submit to a reduction of dividend, in order to clear off the account at once, "so as not to have a millstone hanging round their "neck," as the Chairman (Alderman Sir H. E. Knight) expressed it. Unfortunately, it seems, with regard to this Company, that the entire expenditure connected with the frost will be as much as £20,000; thus throwing a further charge of £9200 on the present half year. Perhaps the estimate may err somewhat by excess. But there can be no misconception as to the amount expended up to March last; and the effect of this is to reduce the half-year's dividend to an annual rate of 4 per cent. in place of 6. Sir H. E. Knight explained to the shareholders that the dividend might have been at the rate of 6½ per cent., if the exceptional circumstances of which he spoke had not occurred. The course adopted by the Grand Junction Company is practically the same as that of the Southwark and Vauxhall; the extra outlay owing to the frost being distributed over the entire year, so as to charge only a moiety on the half year just past. By this arrangement, the dividend, although diminished, is at the rate of 7 per cent. per annum. One of the Company's Auditors objected to the plan thus laid down; but the other Auditor agreed with the Directors; and the Chairman of the meeting (Mr. Tendron) read a letter from Mr. Allen Stoneham, the Government Auditor, recognizing the propriety of distributing the exceptional expenditure over two half years, as proposed. But it is not the fact that the expenditure of the Grand Junction Company in respect to the frost came to an end last March. The report of the Directors states that the work of renewing and replacing injured mains is still going on. If so, an extra expenditure must accrue since March; and Mr. Fraser, the Company's Engineer, has estimated this at £6000, in addition to the £6000 expended up to the close of the last account. It would obviously be unreasonable to charge the whole £12,000 to the past half year; for, although the frost occurred in that period, the repairs have been going on subsequently.

Although the extraordinary expenses to the extent of £20,000 which have befallen the Southwark and Vauxhall Company represent more than a moiety of the half-year's earnings, Sir H. E. Knight is able to show that this exceptional burden, the end of which will be seen in another six months, does not affect the permanent prosperity of the undertaking. After this year, the shareholders are led to anticipate a return of their old rate of dividend, or even something better. So far as the earning of profits is concerned, the Company are really more prosperous than they were a year ago. The water-rates show an increase of £2000 on the half year; and but for extraordinary circumstances, there would have been an enlarged profit to the same extent. Some of the more ordinary events are adverse, though not sufficiently so to affect the real prosperity of the Company. The Conservators of the Thames take nearly £1400 per annum more from the Company than before the passing of last year's Act. Rates and taxes are perpetually increasing. The County Council are continually heaping parliamentary expenses on the Southwark and Vauxhall Company as well as on the other Companies; and Sir H. E. Knight estimates that his own Company have thus been put to an expense averaging £2000 per annum during the past five years, or £10,000 in all. The total for the eight Companies in these five years may thus be reckoned at £80,000, in addition to the ratepayers' money expended by the Council—the Companies also having the satisfaction of contributing largely under this head. Respecting additional storage reservoirs, some interesting statements were made at the Southwark meeting by Sir H. E. Knight, who described the progress that was being made with the Company's works, and combated the idea that the Royal Commissioners were wedded to the Staines scheme. At the Grand Junction meeting, Mr. Tendron shrewdly pointed out that while, in respect to the water supply, the Engineer to the County Council estimated the daily requirements of London in 1941 at 35 gallons per head for a population of 12 millions, drainage was only provided for a population of 7 millions at that date.

Alderman Arthur Ashton, the Chairman of the Huntingdon and Godmanchester Gas Company, died on the 2nd inst., at the advanced age of 83 years. He had been a Director of the Company since 1853; and, upon the death of the late Earl of Sandwich, he was elected Chairman.

Mr. T. Ebenezer Pye has been appointed Manager of the Bastia (Corsica) Gas-Works. Mr. Pye, we believe, was among the selected candidates for the recent vacancies at Carlisle and Plymouth; and he is to be congratulated on so soon securing a fresh appointment after severing his connection with the Shrewsbury Gas-Works.

Mr. D. Williamson, who has relinquished the management of the Ballybay Gas-Works to take the supervision of those at Clones, has been presented with a beautiful service, by his friends in the former town, as a token of their high esteem for himself and Mrs. Williamson, who had, they said, become endeared to them during their seventeen years' residence. Mr. Williamson, in acknowledging the gift, assured the donors that it was highly appreciated by his wife and himself, and that the consciousness that they had secured so many sterling friends would ever be a source of gratification. They cordially reciprocated the good wishes which accompanied the present.

Death of Mr. G. Rose-Innes.—The death was announced last Wednesday of Mr. George Rose-Innes, a prominent member of the Corporation of London. It took place on the previous day, after some months of ill-health, which towards the last compelled him to withdraw from public life. Mr. Rose-Innes became a member of the Corporation in 1868, and was Chairman of the Commission of Sewers and several important Committees. He was specially interested in questions relating to gas and water supply. He assisted largely in the promotion of the Water Bill by the Corporation and the London County Council; and he was a member of the Standards of Light Committee appointed by the Board of Trade. He was in his 55th year.

Honorarium and Increase of Salary for Mr. J. Tindall.—The extra work which has devolved upon Mr. J. Tindall, the Engineer of the Walsall Corporation Gas-Works, in connection with the extensions at the Pleck station, has been recognized by an honorarium of £100; and, in consideration of his long service and additional duties, his salary is to be raised by £50 per annum. The extensions referred to were designed and carried out by Mr. Tindall, at a cost of £35,000. The Mayor (Mr. Noake), in moving the adoption of the Gas Committee's recommendation at the meeting of the Council on Monday last week, said he considered Mr. Tindall was well entitled to the honorarium and the advance, considering the good work he had done. Mr. Brownhill, the Chairman of the Gas Committee, bore testimony to the value of Mr. Tindall's services. He said he had worked under the Corporation for 25 years, and had spent the best part of his life for them; and no one could say that he had not always been industrious, persevering, and attentive to his work. He did not know any man in any undertaking who had been more conscientious, honest, and straightforward.

Estimation of Paraffins in Crude Anthracene.—A new method has recently been devised by MM. Heusler and Herde for the estimation of paraffins in crude anthracene. The *rationale* of the process depends on the complete solubility of the whole of the crude anthracene, with the exception of the paraffin, in fuming nitric acid (HNO_3). The following is the method of procedure as advised by the authors: Not less than 2 grammes of the crude anthracene are weighed off into a small flask of about 150 c.c. capacity, which is surrounded with iced water. Fuming nitric acid is then introduced drop by drop, in the proportion of 25 c.c. to every 2 grammes of crude anthracene. When all the nitric acid has been added as directed, a complete solution of the anthracene will have been obtained. The flask is then warmed on the water-bath for a short time until all the paraffin is melted. After cooling, the paraffin can be collected on a small asbestos filter, where it is washed with fuming nitric acid until a drop of the filtrate shows no turbidity with water. A thorough washing with water is next given, till the filtrate no longer gives an acid reaction with blue litmus paper. A fresh receiver is then placed under the funnel, the paraffin washed through into it with alcohol, and finally with ether which has been slightly warmed. The alcoholic solution is then transferred to a weighed porcelain basin, and evaporated on the water-bath; after which ethereal solution is added, and the ether allowed to evaporate in a warm place. The paraffin which is left is dried for half an hour at a temperature of 150° to 110° C., allowed to cool in the desiccator, and finally weighed.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE THIRTY-SECOND ANNUAL GENERAL MEETING,

HELD AT THE

QUEEN STREET HALL, EDINBURGH, JUNE 11, 12, & 13, 1895.

ROBERT MITCHELL, Esq., President.

REVIEW OF THE PROCEEDINGS.

THE Edinburgh meeting of the Incorporated Gas Institute opened last Tuesday morning under very favourable auspices. The weather was fair, though cool; and a large number of members signed the attendance registers at the Queen Street Hall—a commodious meeting-place, albeit not blessed with supremely good acoustic properties. With praiseworthy punctuality, the President (Mr. Robert Mitchell), supported by the Council and officers of the Institute, entered the hall at eleven o'clock, and took his place, amid the plaudits of the assembly, on a platform which was prettily set off with flowers and foliage plants. His first words were an introduction of the Lord Provost of the city, who came, accompanied by several members of the Corporation, to extend a formal welcome to the Institute. The Lord Provost's speech was brief and to the point. He referred to the large outlay recently made by the Corporation upon an electric lighting undertaking; and he might have said, but did not, that this adventure came uncomfortably close upon the heels of the larger venture by which the ratepayers acquired the gas supply. Edinburgh, in point of fact, is the only city that has entered upon these two kinds of trading within the same decade. The citizens have no reason to be otherwise than satisfied with their gas purchase; and it is to be hoped equal satisfaction will attend the electric light venture, though the financial prospects of the two departments of municipal enterprise are not exactly the same.

The Lord Provost was followed by Bailie Kinloch Anderson, who, as Convener of the Gas Committee of the Corporation, naturally went a little further into particulars in regard to the gas supply. In his remarks, he gave satisfactory indication that the Corporation do not intend to permit their fine gas property to remain in the stagnant condition, as regards equipment, to which circumstances compelled the old Companies to submit. The thanks of the Institute for the Lord Provost's welcome were tendered by the "Orator-in-Ordinary" of the Institute, Mr. Denny Lane, who had a warm reception from an assembly which always rejoices in his flowing periods. He was supported by Mr. W. R. Chester, whose election as President for the coming year was later on announced. Mr. F. G. Burfield, the Secretary of the Institute, then read the annual report of the Council, already commented upon in the JOURNAL; and this statement was adopted by the meeting without discussion. The regretful mention made to the loss of the services of the late Honorary Secretary, Mr. J. Hepworth, was sympathetically received. Next came the presentation of premiums and the President's Medal for the papers of last year. Mr. James Stelfox, of Belfast, received, as was to have been expected, the medal and the first premium; the second premium going to Mr. Chester; and the third, to Mr. William Chew, of Blackpool. Mr. Mitchell then delivered his Inaugural Address, the text of which we published last week.

Of the merits of this composition there is not much to be said beyond a general expression of acknowledgment of the excellence of its style. It is with no disrespect to Mr. Mitchell that one remarks of him that he has not rendered himself conspicuous in the ranks of the followers of the British gas industry by any considerable originality of views or tendency to experiment in practice. He has served Edinburgh well as a maker of the coal gas with which the city has been accustomed to light itself—not too lavishly—withal; and with this reputation he is probably quite content. His address is like himself—unpretentious, practical, and not destitute of those occasional flashes of sly humour by which the driest of his compatriots are given to surprise and interest the world. Taking it all through, the diction of Mr. Mitchell's address is really admirable. The matter flows on easily, and even gracefully; and if there cannot honestly be said to be a great deal in it, what there is is well said. In one place in particular—the passage in which the President exalts the value of plodding, apparently insignificant, labour, in contrast with flashy triumphs which may be secured by good luck as easily as by good management—the address rises into something very like eloquence; and it is impossible for one to avoid hearing in these words the echo of a life's experience.

Curiously enough, Mr. Mitchell makes particular mention in his address of those statistics from Massachusetts respecting fatalities from the careless or improper use of illuminating gas in the United States to which reference has recently been made in the JOURNAL. He entertains a good opinion of carburetted water gas—not as a bulk producer, but as an enricher; and he appears to have been impressed in advance with the desirability of showing its innocuousness when fairly treated. It is just as well for gas managers contemplating a trial of this system of gas manufacture to show that they do not overlook the case that has been made out upon American data against the distribution of gas containing a high proportion of carbonic oxide; but there is some danger lest the point should be over-laboured.

One matter came out prominently in the address, and this was the extent to which in the United Kingdom, and especially in Scotland, gas undertakings are still carried on in the absence of statutory protection. This may be a natural consequence of the smallness of many of the undertakings in question, and the costliness of parliamentary action, even under the merciful auspices of the Board of Trade. But it arouses a feeling of regret that any capital sunk in the supply of gas should remain under risk of depreciation from such a cause. Could not the County Councils intervene in a matter of this kind? These bodies have not now, of course, any powers to help Gas Companies; but it seems desirable that there should be greater uniformity in the standing of gas capital when earning reasonable dividends.

It is to be regretted, as Mr. Mitchell observed, that the subjects of carburetted water gas and oil-gas making according to modern principles were absent from the *agenda* of the Institute. There is no Scottish water-gas system, though the product itself is not unknown in Scotland; but the northern realm justly prides itself upon the Peebles process, which at one time bid fair to be the fruitful parent of a various progeny. So far as the present year's Institute proceedings are concerned, however, the Peebles system is quiescent. If anything in the nature of a bulk producer, as the President hinted, is coming of it, nothing was to be heard on the subject in Edinburgh.

The President waxed eloquent again on the subject of consumers' fittings, of which he had some really gruesome experiences to relate. In sooth, the confidence of the "jerry" builder in the carrying capacity of small piping is everywhere touchingly in evidence. But in Scotland, where the nominal richness of the gas lends some support to the idea, this confidence is apt to run over into strange excesses of credulity. Mr. Mitchell had a very shrewd remark or two to make respecting the causes of the popularity of the incandescent gas-light, which, it seems, is making great headway in Edinburgh, notwithstanding the traditional brilliancy of the gas. This is partly to be accounted for by the circumstance that the rate of consumption of gas by these burners commends itself to the predilections of the populace. It is, indeed, somewhat farcical to speak of the illuminating value of gas when burnt at the rate of 5 cubic feet per hour, while, as a matter of fact, hardly anybody thinks of using it at anything like so liberal a rate. A small consumption, with a good lighting effect, is a result after the heart of the Edinburgh householder.

It was strange for Mr. Mitchell to express himself so pointedly as he did upon the South Metropolitan workman-director proposal; also to pronounce against the idea of cheapening gas by reducing the nominal illuminating power. His later observation that the recommendation of the Standards of Light Committee does not favour the latter idea, so far as London gas is concerned, is rendered meaningless by the consideration that the matter did not come within the terms of the reference. These little errors, however, do not amount to much; and they certainly do not detract from the credit which the address as a whole will earn, on all hands, for its author.

After the President had sat down—having received the

customary (and, in this case, well-merited) vote of thanks—Mr. C. Stafford Ellery, of Bath, read to a diminished, though appreciative, assembly his practical paper on the manufacture of sulphate of ammonia. The paper was more instructive than debateable. Upon reassembling after the luncheon recess, the members found the hall darkened for what was confessedly a lecture on "Illumination," by Professor Ivison Macadam. The title seemed a misnomer; and the contribution itself cannot be properly described as otherwise than disappointing. The author, it appears to us, did not take advantage of a good opportunity; and the chief result of his labours—accentuated by some pointed observations by Mr. John West—was to show that the Welsbach burners have rendered highly carburetted gas a mistake for illuminating purposes. The technical business of the day was wound up by Mr. D. Irving, of Bristol, whose laborious paper on "Unaccounted-for Gas" was instrumental in evoking strong proofs of the interest the subject possesses for members of the gas engineering profession.

The reception and conversazione given on the Tuesday evening by the Edinburgh and Leith Corporations Gas Commissioners was largely attended by a brilliant company representing the city and town, besides the members and friends of the Institute. The Music Hall of the George Street Assembly Rooms, where the Lord Provost and Mrs. M'Donald received the guests of the Commissioners, was prettily decorated; and nothing was omitted that could have lent distinction to the occasion, or added to the enjoyment and amusement of the company. The organization of the function was perfect; and great credit is due to Mr. James M'G. Jack, the Clerk to the Gas Commissioners, for the thoroughness with which all the arrangements were devised and carried through.

Wednesday's business opened rather slackly—after the previous night's festivities—with the reading and short discussion of Mr. F. W. Cross's paper on the practice of districting, as illustrated by the example of Hong Kong. There was not much to say upon this subject; and as quickly as possible the President called upon Professor Vivian B. Lewes to give his lecture on "Acetylene." It afforded a great treat to the large audience, and was listened to with intense interest and rapturous appreciation. As the text of the lecture appears to-day in another column, it is unnecessary to say here what it was all about. But those of our readers who were not forunate enough to hear it delivered, and may be inclined to suspect it of being a *réchauffé* of something they had heard before on the subject from the same source, are to be advised that it is nothing of the kind. It contains a mass of fresh matter, and was illustrated in the delivery by a number of equally novel demonstrations. Immediately after his lecture, Professor Lewes had to read his paper on "The Combustion of Coal Gas for Fuel Purposes," which covered rather more ground than the title promises, inasmuch as, while it brought into prominence the results of some experiments which go to show the superiority of the Siemens type of regenerative stoves to the common run of English trade articles sold for the same purpose, it also introduced the "holophane" globes and the Denayrouze improvement upon the incandescent gas-lamp. We shall have something more to say respecting these matters on another occasion, and so need not discuss Professor Lewes's statements here. It is enough for the present to record the fact that he carried the meeting with him by virtue of that combination of matter, style, and *bonhomie* of which he possesses the mastery in so superlative a degree.

The remainder of the papers do not call for extended comment. Mr. Lewis T. Wright's paper was eminently instructive; Mr. M'Crae's was opportune and well-meaning; and Mr. Medhurst's was—well, it is difficult to qualify his paper fairly without seeming to reflect upon the wisdom of the Council in admitting it. The rest of the doings of the members and friends of the Institute in and about Edinburgh last week may be summarized in a sentence. They drove on Wednesday afternoon to the Forth Bridge—stopping on the way to be sumptuously refreshed by Mr. James M'Kelvie, at Gogar Park. They went a long round from the Clyde on Friday; the trip being admirably planned by Mr. J. M'Gilchrist, of Dumbarton, who is the "Convener-General" of the Scottish gas industry. They parted at the last with the cognizance that they had had a very pleasant time in Scotland—thanks to the country, the capital, the climate, and in no small measure to the co-operation of gentlemen not to be found mentioned in the official programme, among others the able assistants of Mr. M'Gilchrist on the Committee of Arrangements for the Friday's trip—Mr. Mitchell, Mr. Samuel Stewart, and Mr. Adam MacPherson.

REPORT OF PROCEEDINGS.

The Thirty-second Annual General Meeting of the Institute was held on Tuesday, Wednesday, and Thursday last week, at the Queen Street Hall, Edinburgh, under the presidency of Mr. Robert Mitchell, the Manager of the Edinburgh works of the Edinburgh and Leith Gas Commission.

An Official Welcome.

The proceedings opened at eleven o'clock on Tuesday morning, when the Lord Provost of Edinburgh (Mr. A. M'Donald) and the members of the Edinburgh and Leith Gas Commission entered the Hall accompanied by the President.

The Lord Provost, on behalf of the citizens of Edinburgh, tendered a hearty welcome to the Institute; and expressed the hope that the arrangements made, both for the business and the pleasurable parts of the meeting, would meet with their approval. They had lately been spending about £125,000 in Edinburgh on electric lighting; but he did not think there need be any fear of the gas industry in any large city being injuriously affected by electricity. A few lights might be discontinued; but the use of gas for heating, cooking, and many other purposes, would far more than make up for any small loss in this direction.

Bailie Kinloch Anderson (the Convener of the Works Committee of the Commission) supported the welcome given by the Lord Provost. He said he did so all the more heartily as the President of the Institute filled so honourably the position of Engineer to the Commission. He did not know that they had much of technical interest to show to gas engineers in Edinburgh; and, having recently had the privilege of visiting several extensive gas-works, he must confess that he felt a little ashamed of the small space and crowded condition of their own. But altogether their operations were carried on very successfully; and this, after all, was the main thing. They had lately been able to materially reduce the price of gas; and, notwithstanding that the electric light had been introduced into the city, the consumption of gas was still increasing. They were adopting modern improvements in the shape of mechanical stoking and coal-breakers; and he hoped that before long carburetted water-gas plant would be erected.

Mr. Denny Lane (Cork), in one of his characteristic speeches, proposed, on behalf of the Institute, a hearty vote of thanks to the Lord Provost and Commissioners for the welcome they had just offered them—a vote which he felt sure would be tendered still more warmly at the close of their visit. Though an Irishman, he had always had the warmest sympathy with Scotland, and the greatest admiration for her system of national education, for her literature, her men of science, and her poets—even going so far as to attempt poems in the Scotch dialect himself.

Mr. W. R. Chester (Nottingham) seconded the motion; and it was carried unanimously.

Confirmation of Minutes.

Mr. C. Stafford Ellery (Bath) moved that the minutes of the last meeting be taken as read, and confirmed.

Mr. Robert Hunter (Chester) seconded the motion; and it was carried.

Appointment of Scrutineers.

Mr. T. Stormonth (Ludlow) and Mr. J. Kincaid (Peterhead) were appointed Scrutineers of the ballot-papers.

Annual Report of the Council.

The Secretary (Mr. F. G. Burfield) read the report of the Council, which was summarized in the Journal for the 28th ult.

Mr. T. H. Martin (New Barnet) moved that the report be received, adopted, and entered on the minutes.

Mr. J. Stelfox (Belfast) seconded the motion, which was at once carried.

Premiums for Papers.

The President said his next duty was to present the

prizes offered by the Council for the papers read at the previous meeting, as follows:—

First Prize (with the President's Medal).—To Mr. James Stelfox, of Belfast, for his paper "On a First Season's Experience of Carburetted Water Gas."

Second Prize.—To Mr. W. R. Chester, of Nottingham, for his paper "On the Construction and Working of Regenerative Settings of Retorts."

Third Prize.—To Mr. William Chew, of Blackpool, for his paper "On the Gas and Electricity Supply of Blackpool."

Mr. STELFOX said he was very much gratified at the great compliment paid him by the award of this prize for the first paper he had ever contributed to the Institute. He could only suppose that he had been very fortunate in taking up a subject which was just then considered of great importance to the gas industry.

Mr. CHESTER also responded; saying it was always a pleasure to prepare papers for these annual meetings, because they were kindly received, and discussed in a friendly manner.

PRESIDENT'S ADDRESS.

The PRESIDENT then delivered his Inaugural Address, which was given in the JOURNAL last week (p. 1241).

Mr. W. A. VALON (Ramsgate) proposed a vote of thanks to the President for his excellent address. He remarked that very few words were needed to express what he had to say; but, having recently passed through a similar ordeal himself, he knew what a great sense of responsibility attached to the duty of having to prepare such an address, and present one's ideas, with some kind of connection, force, and novelty, to an audience such as that composed of members of the Institute. On the present occasion, Mr. Mitchell had given an address full of ideas, and containing much historical and statistical information, which would be read with great interest and profit.

Mr. J. WEST (Manchester) expressed his pleasure in seconding the proposition. The address was most interesting; and he was sure it would be studied with much advantage.

The motion was carried by acclamation.

READING OF PAPERS.

The reading of papers was then proceeded with. These, and the lectures arranged for, were taken in the following order:—

Tuesday.—(1) "Some Improvements in the Methods of Manufacturing Sulphate of Ammonia." By C. STAFFORD ELLERY, of Bath. (2) "Illumination." A lecture, with illustrative experiments, by Professor IVISON MACADAM, of Edinburgh. (3) "Unaccounted-for Gas." By D. IRVING, of Bristol.

Wednesday.—(4) "The Practice of Districting, with a View to the Equalization of Pressure." By F. W. CROSS, of Wellington, Salop. (5) "Acetylene, and the Part it Plays in the Luminosity of Flame." A lecture by Professor VIVIAN B. LEWES. (6) "Combustion of Coal Gas for Fuel Purposes." By Professor VIVIAN B. LEWES. (7) "The Transfer of Gas and Water Works Undertakings to Public Authorities." By W. NEWBIGGING, of Manchester.

Thursday.—(8) "The Management of, and Remuneration to, Gas Workers." By JOHN M'CRAE, of Dundee. (9) "Washing." By LEWIS T. WRIGHT, of London. (10) "Gas as a Motive Power in Generating Electrical Energy for Private and Public Lighting." By F. H. MEDHURST, of London. The paper by Mr. W. SUGG, on "Photometry as Applied to the Verification of the Illuminating Power of Gas Supplied to Towns," was taken as read, owing to the absence of the author.

We give to-day the lecture by Professor Lewes; and the papers, with a report of the discussions thereon, will appear in succeeding issues.

REPORT OF THE SCRUTINEERS.

On Thursday afternoon, the result of the balloting for the election of office-bearers for the ensuing year was declared, as follows:—

President.—William R. Chester, of Nottingham.

Vice-Presidents.—C. Stafford Ellery, of Bath; J. Stelfox, of Belfast.

New Members of Council.—W. D. Child, of Romford; D. Irving, of Bristol; S. Y. Shoubridge, of Salford; S. Stewart, of Greenock.

Auditors.—Alfred Lass, F.C.A., of London; T. H. Martin, of New Barnet.

Hon. Secretary.—A. Dougall, of Tunbridge Wells.

Benevolent Fund Committee.—Robert Hunter, of Chester; C. Stafford Ellery, of Bath.

NEW MEMBERS.

The SECRETARY read the following list of new members and associates. These gentlemen were duly admitted to the membership of the Institute; and the applications of those desirous of being transferred to the class of members were acceded to.

Members.—Barrett, R., Clitheroe; Beecham, E. M., Cirencester; Bird, A., Bromsgrove; Brown, T., Matlock Bridge; Burtonshaw, W. H., Skipton; Carmichael, J. W., Barrhead; Cawley, A. R., Ystrad; Channon, P. P., Haywards Heath; Clark, F., Southend; Cockey, F. G., Newport (I. W.); Cotton, W. F., J.P., Dublin; Crowther, J. H., Wallasey; Cummins, J., Ennis; Donaldson, J., Cambuslang; Dunn, M., Selby; Forrett, A., Blackwell; Hall, J., St. Andrew's; Hall, R., St. Andrew's; Hutchison, S., Melbourne; Jervis, J. J., New Swindon; Keogh, W., Killarney; Kincaid, J., Peterhead; Lee, J., Wirksworth; Lister, W., East Ardsley; Lyne, J. J., Enniscorthy; Martin, M., Drogheda; M'Gill, R., Denbigh; MacPherson, J., Cupar; Millar, W., Cookstown; Oke, F. R., Crewe; Pym, J., Belper; Randall, J. T., Southend; Robertson, W., Campbeltown; Sandell, R., St. Mary Axe, E.C.; Settle, T., Knaresborough; Simpson, R. T., Guildford; Smith, J. D., Selkirk; Taylor, O. D. S., Newtown (Mont.); Waddell, F., Forfar; Watson, R., Hertford; Webb, T. C., Slough; Wharton, A., Plymouth; Whyte, W., Penicuik; Wright, Lewis T., London; Young, G. W., Harrington; Yuill, A., Alloa.

Associate Members.—Airth, G., Paisley; Clarke, A., Sutton-in-Ashfield; Clarke, A. L., Maldon; Fifield, C. H., Worthing; Gracie, H. H., Edinburgh; Hislop, R. F., Paisley; Moon, F. C., Scarborough; Rhoades, J. C., Mitcham; Saville, A. E., Darwen.

Associate.—Young, W., Peebles, N.B.

Transferences.—Associate Members to Members: Bottle, F. W., London; Surman, W., Braintree; White, T., Paignton; Glover, T., West Bromwich.

AN HONORARY MEMBER.

The PRESIDENT then moved that the President of the Société Technique du Gaz en France be elected as an honorary member of the Institute.

Mr. DENNY LANE, in seconding the motion, said he had the honour of being an honorary member of the French Society; and it was only right to reciprocate the kindness they had always shown to members of the Institute.

The resolution was carried unanimously.

VOTES OF THANKS.

Mr. W. R. CHESTER moved that the cordial thanks of the members be presented to the Lord Provost, for the hospitable manner in which he had come forward to welcome the Institute to the ancient and royal city of Edinburgh; and also to the Edinburgh and Leith Gas Commissioners, for their hospitable entertainment on Tuesday evening. He remarked that it was always a matter of gratification to the Institute to receive a welcome from the governing bodies of the various places they visited; but on no occasion that he could remember had they met with a warmer welcome than they had received in Edinburgh. He hoped that a copy of the resolution would be forwarded to the Lord Provost and the Gas Commissioners.

Mr. S. STEWART (Greenock) seconded the motion; and it was carried unanimously.

Mr. T. N. RITSON (Kendal) proposed a vote of thanks to the readers of papers. He said that anyone who had been called upon to prepare a paper for The Gas Institute, or for any other scientific society, knew what an amount of labour was required to put the matter into suitable shape for such a meeting, and would appreciate what had been done by the authors of papers. The standard had been fully maintained on the present occasion; and he might specially refer to the admirable lecture given by their friend Professor Lewes.

Mr. D. Terrace (Middlesbrough) seconded the motion, which was unanimously agreed to.

The thanks of the members were also accorded to the Scrutineers (Messrs. Stormonth and Kincaid) and to the Auditors (Messrs. Lass and Child.)

Mr. W. A. Valon (Ramsgate) proposed a vote of thanks to the Council, for their labours during the past year, and for so successfully conducting the business of the Institute. There were, he said, many present who had served on the Council, and knew what was required of them. There was an immense amount of detail work to be done; and some gentlemen had to travel hundreds of miles to attend to the affairs of the Institute.

Mr. C. Farrand (Coventry) seconded the motion, which was carried by acclamation.

Mr. T. H. Martin (New Barnet) proposed a hearty vote of thanks to the President, for the way in which he had presided over their deliberations. They were all, he remarked, deeply indebted to him for the arduous work he had performed during the past year; for it was no light matter to run up and down to London as he had done on many occasions. Their thanks were greatly due to him for the very successful meeting they had held.

Mr. J. M'Gilchrist (Dumbarton) said he had much pleasure in seconding the proposition. He knew that what Mr. Mitchell had done had been a labour of love to him; and they could all judge of the success which had attended his efforts.

The motion was cordially adopted.

The President thanked the members very sincerely for the vote of thanks. He said it had given him great pleasure to do what he could; and he only regretted that, on account of his health having been for some time uncertain, and through being much engaged in reporting on various processes, he really had not had the time at his disposal to do as much as he should have liked. He was very pleased to think that what he had been able to do had met with the approval of the members.

Mr. Denny Lane said he had to move a resolution of no ordinary character; and he did it with mingled feelings. They were all aware that, when a secession took place of some of their members, and a new society was formed, the older Institute was for a time threatened with failure. A storm arose in which it was said that their little pinnace would be sunk, while the grand frigate alongside would ride the waves. Many members remained faithful to the Institute; but it was necessary that there should be a pilot at the helm in the stormy time, and that pilot they found in Mr. Hepworth. Up to the present time, he had been Honorary Secretary to the Institute; and how he had performed the duties, they all knew more or less. But those who had served on the Council, and were brought into more intimate connection with him, knew still better. A very few years ago, when he (Mr. Lane) undertook, for the second time, the office of President, his duties were made much easier—indeed, it was only possible for him to undertake the office—in consequence of the kind assistance of Mr. Hepworth. It had been said that a pint of oil would go farther than a gallon of vinegar; and one reason why Mr. Hepworth succeeded so well in managing the affairs of the Institute was the remarkable urbanity and courtesy of his manner. There was one kind of courtesy which was like French polish—entirely on the outside; and there was another kind which arose from innate good nature, and a desire to serve others. The latter was the kind of courtesy which Mr. Hepworth displayed. If they searched the ranks of any society, they would never find a man more admirably suited to perform the duties which he undertook, and which he carried on for so many years with so much satisfaction to everyone. He (Mr. Lane) therefore had the greatest pleasure in proposing that the most marked thanks of the members of the Institute be given to Mr. Hepworth, for his services as Honorary Secretary; and he was sure no vote of thanks would be carried with more enthusiasm.

Mr. J. West, in seconding the motion, said it was not necessary to add much to the remarks which had been made. They all knew Mr. Hepworth; but those who knew him most intimately loved him most. There were comparatively very few who knew the real amount of work he had done for the Institute. During the critical period which had been referred to, Mr. Hepworth "poured oil on the troubled waters;" and it was in a great measure owing to his tact, patience, and untiring energy, that they were able to weather the storm. Though he was leaving them, he (Mr. West) was glad to think they would still have him often among them. In conclusion, he must say (but he had had no instructions on the matter) he thought it would be only right to intimate their appreciation of Mr. Hepworth's services in some more tangible way than by a vote of thanks, though he was sure Mr. Hepworth would appreciate a hearty expression of their opinion as much as anything else.

Mr. Valon said he was so fully in sympathy with the remarks of Mr. Lane and Mr. West, that he would ask the President if he would put it to the meeting that the Council be empowered to enter into some arrangement by which a suitable acknowledgment of the services of Mr. Hepworth might be put on record, and some portion of the funds of the Institute appropriated to form the nucleus of a testimonial.

The President said he must first dispose of the resolution before the meeting.

This was then put, and carried by acclamation.

Mr. Denny Lane said he would accept Mr. Valon's suggestion as a supplementary motion, which he should be glad to second—that the Council set on foot, from the funds of the Institute, a subscription towards a testimonial which should form a permanent recognition of Mr. Hepworth's services.

The President said the Institute were very deeply indebted to Mr. Hepworth, not only for his services as Honorary Secretary, but in many other ways; and it must certainly be a matter to be taken up by his (the President's) successor—Mr. Chester. It might be as well to have an expression of the opinion of the meeting on the matter.

Mr. J. M'Gilchrist remarked that he did not think the Institute ought to take private subscriptions at all; and he would move an amendment more in accordance with what he understood Mr. Valon to suggest—that the funds of the Institute be appropriated to a testimonial.

Mr. Denny Lane said he did not object to that; but he should feel it a privilege to contribute personally.

Mr. Isaac Carr said he would second the amendment. The excellent service Mr. Hepworth had rendered to the Institute was well known to every member. But it was much better known to the Council; and he thought the matter should be left entirely in their hands.

Mr. W. W. Hutchinson (Barnsley) supported the amendment.

Mr. Denny Lane said, as it appeared to be the opinion of the meeting that it would be better to leave the matter in the hands of the Council, he would be quite willing that the resolution should be put in that form.

The Secretary then read the resolution, as he had drafted it, to express the views which had been put forward: "That the Council be empowered to vote such sum as they may think sufficient from the funds of the Institute towards showing, in some tangible manner, the high appreciation of the members of the Institute of Mr. Hepworth's services as Honorary Secretary."

This was carried unanimously.

Mr. Hutchinson then moved a vote of thanks to the Secretary, Mr. F. G. Burfield. He remarked that the energetic way in which the Secretary attended to his duties, and the attention he paid to the numerous details of the office, commended him to everyone; and the unvarying courtesy they always received at his hands merited their highest approbation.

Mr. H. Tobey (New Malton) seconded the motion, which was carried unanimously.

Mr. Burfield briefly acknowledged the vote.

Place of Next Meeting.

Mr. T. H. Martin moved that the meeting next year be held in London, on a date to be fixed by the Council.

Mr. W. Duff (Morecambe) seconded the motion; and it was unanimously agreed to.

Thanks to the Press.

The President said there was one other vote of thanks which he should like to propose, and that was to the Press, to whom they were much indebted for reports of their proceedings. They were remarkably accurate; and if ever they did make a slip, they were always the first to acknowledge it.

The motion was carried, and briefly acknowledged by Mr. Walter King.

The New President.

Mr. Chester then expressed his thanks for the honour done him in electing him to the presidency for the ensuing year. It would, he said, be his duty to carry on the traditions of the Institute in the same honourable way as had been done by his predecessors during the last twenty-five years. If he could do anything which would tend to put the Institute into even a more honoured, a more prosperous, or a more permanent position than it at present occupied, it would be his ambition to do it.

The proceedings then closed.

The Benevolent Fund.

At the conclusion of the business on Tuesday, the Annual General Meeting of the Donors and Subscribers to the Benevolent Fund was held—the President in the chair. The business was purely formal.

The minutes of the previous meeting having, on the motion of Mr. Robert Hunter (Chester), seconded by Mr. C. Stafford Ellery (Bath), been taken as read, they were confirmed.

The report of the Committee, which had been previously circulated among the subscribers, was also taken as read; but a short discussion took place thereon with regard to the position and working of the fund.

Mr. J. Hepworth said they gathered from the report that the claims upon the fund during the past year had been greater than the income. But he did not himself look upon this state of things as at all serious; and he should not despair if the claims next year were to be much in excess of the income, for he had no doubt that, when the necessity arose, there would be a prompt increase in the subscriptions to meet the outlay. Still, if the fund could be made a little more active, it would be well. He knew that some of those who received the benefits were of opinion that they could do with a little more. There was no doubt that, in certain cases, larger sums might be given with advantage, if the funds allowed; and he did not think the subscribers would complain next year if there were a still larger deficiency, arising from greater generosity on the part of the Committee. Again, he had received a number of letters of a most distressing kind from the wife of a manager of a gas-works, who was out of health, had met with an accident, had got into debt, and altogether was in very great difficulties. He had recently sent a very small donation; but this lady was still pressing that her circumstances should be brought before the Institute. He did not quite see how the Committee could give help in such a case, where the manager was still in his situation; but if the Committee thought a little temporary relief could be afforded, it would be very gratefully received.

Mr. C. Stafford Ellery said it would be a very serious matter to set a precedent of increasing a man's salary. He did not think the fund was ever intended for cases of that kind.

Mr. H. Tobey remarked that they were all sorry to hear that there were more claims on the fund than the income was able to meet, and that the Committee were obliged to make an appeal for more liberal subscriptions. It always struck him, however, that there was no need to give more when there was so much money lying idle. He would recommend that the money invested should be expended, if suitable cases presented themselves; and when it was all gone, he was sure more would be cheerfully provided.

Mr. P. Simpson (Rugby) thought it would be very bad policy to expend the invested capital. On the contrary, it ought to be increased, if possible, so as to afford a secure annual income for distribution?

Mr. D. Irving (Bristol) did not think there was any need to draw on the reserve fund. If, he said, a statement were put forward of what was required, he felt sure there was money enough and heart enough in the profession to provide the necessary funds.

Mr. Tobey said he should be pleased to increase his subscription when the reserve fund was exhausted; but he did not see the need of it—and he believed many others had the same opinion—while there was so much money lying idle.

Mr. Hunter thought they had better put Mr. Tobey on the Committee next year; and when he saw the large number of applications for assistance which came in, he would probably be convinced of the necessity for keeping something in hand.

ACETYLENE AND THE PART IT PLAYS IN THE LUMINOSITY OF FLAME.

A Lecture by Vivian B. Lewes, F.I.C., F.C.S.,
Professor of Chemistry at the Royal Naval College, Greenwich.

Three years ago, I had the honour of lecturing to you on the occasion of the Murdoch centenary meeting in London; and I chose as my subject: "A Century of Work on the Development of Light from Coal Gas." In that lecture, I traced the genesis of the illuminating gas-flame, and tried to make interesting the theories which had from time to time been advanced as to the cause of the luminosity which gives our gas its greatest value. Starting with the enunciation by Sir Humphry Davy of his celebrated incandescent particle theory, I showed you how it had held undisputed sway for over half a century, until Dr. Frankland's attack upon it in 1868, in which he suggested that, instead of carbon particles yielding the incandescence, dense hydrocarbon vapours at an excessively high temperature gave the light. This hypothesis, giving rise as it did to an enormous amount of fresh work, increased to a large extent our knowledge of the actions which take place in the flame.

After reviewing the work which had been done in this direction, I pointed out that the chemical actions which were taking place in the inner non-luminous zone of the flame, and which were due to the baking action of the walls of flame upon the hydrocarbons in the gas, appeared to me to be of enormous importance, and to play a leading part in the actions which lead to the emission of light. I was able to show experimentally at that date that, under the baking influence exerted on them, the hydrocarbons of the burning gas were converted into a compound of carbon and hydrogen called "acetylene;" and I surmised that it was this body which, by its decomposition, gave the solid particles of carbon which Sir Humphry Davy looked upon as the prime necessity for luminosity, or which by polymerizing, gave the dense hydrocarbon vapours which Dr. Frankland imagined were heated to incandescence.

Since that time, I have continued to work upon illuminating flames and the actions taking place within them. The accidental discovery of a comparatively cheap method for producing calcic carbide, from which pure acetylene can be easily and rapidly prepared, placed a new weapon of research in my hands; and I hope to interest you this morning with the conclusions I have arrived at with regard to the causes which lead to the luminosity of hydrocarbon flames, and to show experimentally some important points on which these conclusions are based.

In a lecture delivered before the Society of Arts last January,* I told the story of the discovery of a cheap method of manufacturing calcic carbide by Mr. T. L. Willson in North Carolina, by which he, taking advantage of the temperature of the electric furnace, fused together coal dust and lime, and by so doing produced a compound of 40 parts by weight of calcium to 2 parts of carbon, to which the name of "calcic carbide" has been given.

The metallic carbides are by no means new creations of the chemist; and it was Sir Humphry Davy himself who, as long ago as the beginning of this century, showed that a compound of potassium and carbon could be produced. Since that time, other carbides have been formed by processes more or less intricate and costly; and the only novelty which can be claimed for the carbide as produced by Mr. Willson is that the simplicity of the method of manufacture, and the low initial cost of the material bring its manufacture within the range of commercial possibility.

Calcic carbide, as I have before stated in my previous papers on this subject, is a dark grey and intensely hard substance, with an almost semi-metallic fracture, and a specific gravity of 2·262. On contact with water, it at once produces a rapid effervescence; the carbide reacting with the water and decomposing it—the hydrogen of the water uniting with the carbon of the carbide to form acetylene, which escapes while the oxygen of the water combines with the calcium of the carbide to form quicklime,

* See *ante*, p. 168; also p. 1191.

which, in the presence of excess of moisture, is rapidly converted into calcic hydrate, or slaked lime. For this reason, the calcic carbide cannot be kept exposed to the moisture of the air, as its surface gets rapidly deteriorated. But the formation of lime on the exterior of the mass to a considerable extent protects the internal portion; so that in lumps it does not deteriorate so fast as might be expected, though in small pieces or powder it is so rapidly acted upon as to necessitate its being kept in closed tins or stoppered bottles.

The acetylene generated by acting upon this compound with water is practically pure; and samples made with merely ordinary precautions give, on analysis, upwards of 98 per cent. of the pure hydrocarbon—the remaining gas consisting of traces of air and sulphuretted hydrogen. The intense garlic-like odour of the acetylene so produced is so much more like phosphoretted hydrogen than it is like the smell which we generally associate with acetylene, that one cannot help suspecting the presence of phosphides in it. But to give the smell, the phosphide would have to be present in large quantities; and I have not been able to detect the presence of this compound, even in traces. The solubility of acetylene in water is very much the same as that of carbon dioxide; while it is far more soluble in alcohol, paraffin, or glycerine.

When a light is applied to acetylene, it burns with a luminous and very smoky flame. On mixing acetylene with air in equal volumes, on application of a light, the mixture burns with a dull red flame, which gives off volumes of smoke, and leaves a residue of soot behind. In the proportion of 1 volume of acetylene to 1·25 volumes of air, the mixture is slightly explosive; and its explosiveness increases with addition of air, until with twelve times its volume of air it reaches its maximum intensity. The violence of explosion gradually decreases as the supply of air is increased; and a mixture of 1 volume of acetylene with 20 volumes of air is non-explosive.

The gas can be condensed to the liquid state with comparative ease. Ansell found that, at the freezing-point of water, a pressure of only 21½ atmospheres is needed for its liquefaction; and the same observer gives 98·6° Fahr. as its critical point—*i.e.*, as the temperature above which it is impossible to liquefy it by any pressure. The pressure necessary at different temperatures is given in the following table.

Temperature. Deg. Fahr.	Pressure. Pounds.	Temperature. Deg. Fahr.	Pressure. Pounds.
− 116·00	15·00	32·00	322·95
− 28·60	135·00	41·45	382·20
− 9·40	165·15	56·30	491·55
+ 14·00	255·90	67·27	596·76

It may be roughly stated that 1 lb. of the liquid, when converted into gas at ordinary temperature, will produce 14½ cubic feet at atmospheric pressure, and that the volume of the gas is nearly 400 times as great as the volume of the liquid.

There should be no trouble whatever in supplying liquid acetylene on a commercial scale, as it is more easily liquefied than carbon dioxide. Instead of the complex pumping machinery necessary for the liquefaction of that gas, the acetylene can be made to liquefy itself by its own pressure; as, if water is added to the carbide in a closed vessel of sufficient strength, the evolved gas soon creates pressure in the generating vessel. This is increased by the fact that the slaking of the lime causes a high temperature; and as the gas continues to be evolved even after the pressure has risen to above 1100 lbs. on the square inch, it is only necessary to connect the generating vessel, by means of tubes and drying-boxes filled with lime, with a steel cylinder kept cool by means of a freezing mixture, for the gas to liquefy. In this way, cylinders can be filled without the costly pumping apparatus necessary for the carbon dioxide.

The liquid acetylene has many of the physical properties of liquid carbon dioxide; and when it is allowed to escape from the high pressure existing in the cylinder to the ordinary atmospheric pressure, it at once becomes gaseous, and renders so much heat latent that some liquid becomes frozen to a solid, and acetylene snow is the result. This can be used like solid carbon dioxide for the production of low temperatures; and if a light be applied to it, it burns with a smoky flame until the whole of it has been vaporized. Experiments with liquid acetylene and the formation of the solid should only be attempted in a strong draught or in the open air.

When acetylene gas is burnt from a No. 000 or even a No. 0000 union-jet burner, the flame, although extremely brilliant, is smoky when the gas is issuing from the nozzle at only ordinary pressures. But on increasing the pressure more and more, the stronger rush of the gas sucks in more air to the flame; and at a pressure of about 4 inches, the No. 000 burner gives a smokeless flame, and develops from the gas an illuminating power which calculates to 240 candles per 5 cubic feet of gas consumed. The necessity for using such pressures as these would, of course, be a drawback in practice; and I have devised a small burner which gives satisfactory and smokeless combustion at pressures even below 1 inch.

The high illuminating value of acetylene, when burned alone, naturally suggested that the gas would be of enormous value for enriching poor coal gas. But in this direction the acetylene has proved disappointing, as its enrichment value is, on an average, not much more than half its illuminating value. The following table gives the increments of light which are to be obtained by the addition of various percentages of acetylene to a low-value coal gas:—

Composition of the Mixture.		Illuminating Value.		Enrichment Value of 1 per Cent. in Candles.
Coal Gas.	Acetylene.	Coal Gas.	Mixture.	
99·10	0·90	13	13·9	1·00
97·90	2·10	13	15·1	1·00
96·00	4·00	13	17·3	1·07
95·20	4·80	13	18·4	1·12
91·00	9·00	13	23·5	1·16
89·50	10·50	13	25·3	1·17
85·00	15·00	13	33·0	1·33
83·25	16·75	13	36·1	1·36
66·90	33·10	13	60·5	1·43
55·50	44·50	13	76·7	1·43
16·70	83·30	13	175·2	1·94
00·00	100·00	—	240·0	2·40

This loss of luminosity makes it clear that the great future of acetylene is to be found in its combustion unmixed with other gases for the development of light; and there is no doubt that its future in this direction is a very great one. The ease of its formation from the carbide, and the simplicity of the automatic apparatus necessary for its continuous production, will undoubtedly offer a very great scope for country-house illumination; and for this purpose there is no doubt that, even with the manufacture of the carbide in its infancy, it can be made at a price which will compare very favourably with the illumination obtained from coal gas. For all purposes where portable illumination is required, acetylene will be of the greatest possible value; and the illumination of railway carriages and tramcars offers a wide field for utilizing this magnificent light. In more particular directions, it will prove itself of great value for lighthouses and buoys, for which its ease of compression into the liquid form renders it specially well adapted, as large volumes can in this way be stored in very small space.

I suppose no description of acetylene and its production from calcic carbide would be considered at all satisfactory if I did not say something as to cost—a subject which, I must confess, I should have much preferred to leave alone until figures that could be absolutely guaranteed were available. The data as to cost which have been from time to time supplied from America vary in the most extraordinary way and between extremes which are both equally ridiculous; and the readers of gas literature will have noticed that even as late as last month, in a paper read before the Franklin Institute, it was stated that there was a probability, or at any rate a possibility, of making carbide at about £1 a ton. But this appears to me to be an absolute impossibility, even with the cheapest of cheap water power to generate electricity; and we shall have to look nearer home for data as to the question of cost, if we are to form any idea on this point.

I have information, which I believe to be reliable, to the effect that in Germany the carbide is being made at 170 marks, or practically £8 10s. per ton; and experiments carried out in England point to the possibility of making it in bulk at about £9 10s. a ton. The figures are strengthened by the consideration that the Swiss Aluminium Company are selling it, packed in hermetically sealed tins, at 6d. per kilogramme, which means £25 a ton; and it is manifest that this could not be done if the cost of production were not about one-third of the selling price. Looking at these facts, I think it will be safe to say that the cost of making it will be between £8 and £12 per ton, and the selling price will be between £10 and £14 per ton;

and if this be so, it will, light for light, be a cheaper illuminant than coal gas.

A ton of calcic carbide generates 11,000 cubic feet of acetylene; and as this is done locally, where the acetylene has to be consumed, the charge for distribution becomes excessively small. The gas develops 15 times more light than 16-candle coal gas; and, therefore, if it costs 15 times as much at the burner, it would be equal in illuminating value to the coal gas. If the carbide cost £19 to £20 per ton delivered, it would only bring the cost per candle to the same as 16-candle coal gas at 2s. 6d. per 1000 cubic feet; and it is for this reason that I think acetylene has a brilliant future before it.

One of the first things that strikes one on seeing the acetylene flame is the intensity of the light emitted, and after having looked at the flame for a few minutes, one feels that such local intensity cannot be good for the optic nerve. Standing here on Scotch soil, I feel that "discretion is the better part of valour," and that the less I say as to my own particular views as to illumination and the superiority of a cheap low-grade gas over gas of high illuminating value, the better. But I think that everyone will agree with me that, given illuminants of such high intensity as acetylene, and the modern forms of incandescent gas-burners, it is necessary to find methods for neutralizing the irritating effect of these high-power lights on our visual organs; and personally I think the introduction of the holophane globes,* which give a perfect distribution and diffusion of the light, and at the same time increase it very considerably for all angles below the horizontal, marks a very important advance in domestic lighting.

Having now given you all the information in my power with regard to acetylene itself, let me try to show you the part which I believe it plays in the luminosity of a hydrocarbon flame; and first of all let me try to demonstrate to you the fact that acetylene is produced in the inner non-luminous zone of the flame. A test by which the presence of acetylene can readily be detected is the property which it has of forming a red acetylide of copper when brought in contact with ammoniacal cuprous chloride solution; and if I introduce the end of a syphon tube into the centre of a luminous flame, I can, without much trouble, draw off some of the gas from the centre of the flame into a flask which contains the blue cuprous chloride solution. On doing this, and shaking up the flask for a moment, you will see the sides at once coated with the red compound which marks the presence of the acetylene. On repeating the experiment with a candle-flame, oil-lamp flame, or, indeed, any other luminous hydrocarbon flame, you obtain the same results; showing that, in one and all, acetylene is produced at the top of the non-luminous zone. Quantitative analysis shows that, before luminosity commences, a very large proportion of the hydrocarbons have been converted into this body.

On looking at the acetylene flame, it occurs to one's mind that, to obtain such intense incandescence of the carbon particles as is evidenced by the whiteness and purity of the light emitted, we must have a temperature far in excess of that which gives rise to the yellow light of burning ethylene or coal gas. But on experimenting with the flame itself, one finds nothing to justify this assumption. The flame is, in fact, so cool, that one can hold one's hand a few inches above it with perfect comfort; and on testing the temperature existing in various parts of the flame with thermo-couples, one finds that it is not nearly so high as an ordinary coal-gas flame or a rich ethylene flame. This experimental fact goes far to shatter one's preconceived idea that the intensity of the light emitted by a luminous flame is dependent upon the heat of the flame. The next point that occurs to one is that, if the generally accepted theories as to the luminosity of flame are correct, the number of carbon particles in a given area of the flame must exercise great influence upon the amount of light emitted; as increasing the number of particles means adding so many more points of light in a given area. If, however, we examine the molecular composition of acetylene, ethylene, and ethane, we find that they all contain the same number of carbon atoms in the molecule, and yet that the illuminating values for equal volumes of gas consumed are 35 for ethane, 68 for ethylene, and 240 for acetylene. Here again it is manifest there is something our present theories do not explain.

It is evident that, if all the hydrocarbons are converted into acetylene before luminosity commences, and if the light is dependent upon liberated carbon particles, or very dense hydrocarbon vapours formed from it, a study of the properties of acetylene is more likely to give us a clue as to the causes of luminosity than any other line of research. When a chemical change takes place, it is always accompanied by a physical change, and this generally takes the form of alteration of temperature; and when two bodies combine together to form a third, the alteration of temperature which takes place is generally the evolution of heat. Taking, as an example, the elementary gases hydrogen and oxygen, and causing them to combine, we have the combination of the two to form water—evolving an enormous amount of heat; and for every pound of hydrogen which enters into combination in this way, enough heat is evolved to raise 34,400 lbs. of water through 1° C. Accordingly, we say that the heat-value of the combination is 34,400 thermal units. There are some cases, however, in which, instead of heat being evolved when a compound is formed, the heat is absorbed—*i.e.*, there is a lowering of temperature; and this makes a very considerable difference in the characteristic behaviour of the compound so formed during its decomposition. If water be taken, in order to once more break it up into its constituents, we have to bring to bear upon it as much energy, either as heat or in any other form, as was evolved during the formation of the water; and this is the reason why such enormously high temperatures are needed in order to dissociate water into oxygen and hydrogen. If, however, heat had been absorbed instead of being evolved, the decomposition of the body again renders the heat of its formation available as sensible heat.

Compounds which give out heat during their formation, and absorb the same amount during decomposition, are called exothermic bodies; while others which take in heat during their formation, and therefore decompose with rise of temperature, are called endothermic. This latter class, though not large, comprises in its ranks several well-known hydrocarbons, such as acetylene and ethylene.

There are methods for measuring the temperature of flames, or of solid matter heated in flames, other than such direct thermometric methods as the thermometer and thermo-couple; and foremost among these stands the *lunette pyrométrique*. On measuring the temperature of the carbon particles in the acetylene flame and in the ordinary ethylene and coal-gas flames, it is at once manifest that the temperature of the carbon particles is higher than the temperature of the flame itself, or of any substances heated in it—as, indeed, one would expect from the quality of the light emitted; and one is met by the difficulty of explaining how this high temperature of the carbon particles can be produced if the flame in which they are present is at a lower temperature than the heated particles themselves. It is at once evident that the temperature of these particles, which emit the light, is dependent upon circumstances apart from the temperature of the flame itself; and the endothermic nature of acetylene naturally turns one's attention to the possibility of the heat stored up in this body playing an important part in the temperature of the liberated particles.

The great French chemist Berthelot, whose researches have played so important a part in the history of explosives and hydrocarbons during the past century, found, while working out his celebrated theory of explosives, that acetylene could be suddenly decomposed into its constituents carbon and hydrogen by the explosion in it of a small quantity of mercuric fulminate, and that this property of being susceptible to detonation was shared by several other gases and vapours of an endothermic character—*i.e.*, which contained heat stored in themselves.

It seemed to me that if the heat already in the body had anything to do with heating up to incandescence the carbon particles in the flame, one ought to be able to detect this on detonating some of the gas. Having first ascertained the amount of light emitted when a charge of 0·1 gramme of mercuric fulminate was fired in a close vessel containing air, I filled the vessel with acetylene, and detonated it with a similar charge of fulminate as was used before, and found that its sudden decomposition into carbon and hydrogen gave rise to a most vivid flash of light—the glass vessel in which the experiment was performed

* A description of the globes here referred to will be found in the JOURNAL for April 16 last (p. 793).

being thickly coated with a deposit of carbon from the acetylene, while the small paper case in which the fulminate had been enclosed was only locally scorched, and not carbonized in the way one would have expected from the great heat suggested by the intensity of the light emitted. Indeed, when the particles of carbon deposited from the acetylene were carefully removed from the paper, it was found that only at the parts where the fulminate had broken through had any charring taken place.

Here, then, we see that it is possible, by the instantaneous decomposition of acetylene, to generate such intense local heating of the carbon particles liberated from the acetylene, as to emit a most vivid light; while the paper gives a proof that this intense heat is so localized in the products of decomposition as to give no time for it to act upon surrounding objects.

Other cases of the same kind occur to one's mind; and, indeed, the ordinary experiment of firing gun-cotton on one's hand or on a heap of powder, without igniting the powder or scorching the skin, is a proof that, when rapid action takes place, though one knows that the temperature must be locally very intense, there is no time for the heat to be spread over the surrounding matter. For instance, the heat of the explosion of gun-cotton is known to be 2650° C., or 4802° Fahr.; and yet it cannot impart the 250° necessary to ignite the powder, or, indeed, to yield more than a pleasant glow of warmth to the skin when fired open upon it. It is perfectly manifest, therefore, that the intense local heating, during decomposition, of the carbon particles in the flame would not of necessity cause an increase of temperature to the flame itself, especially as the temperature recorded by thermometric instruments placed in the flame only gives an average temperature of a considerable area of the flame, and not the temperature of the molecular particles in which the carbon exists.

A still more simple method of showing the fact that acetylene decomposes into carbon and hydrogen with emission of light, and one less trying to the nerves in the morning than detonation, is to pass acetylene through a fine tube made of hard glass, and to heat 4 or 5 inches of this tube by means of a flat-flame Bunsen burner. It is now possible to obtain glass tubing which will stand for a short period a temperature of nearly 1000° C.; and in performing this experiment, we find that, as the acetylene enters the heated portion of the tube, it decomposes, and gives the appearance of a small lurid flame burning in the interior of the tube, while the clouds of carbon liberated by this decomposition flow forward through portions of the tube heated to an even higher temperature than that which brought about the decomposition, but emit no light. I do not think any clearer proof can be adduced that the decomposition of the acetylene will heat the carbon particles to a temperature at which they will emit light.

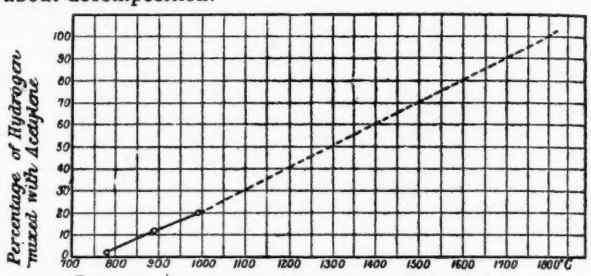
Here, then, I think, we have the chief factor in the luminosity of hydrocarbon flames. It by no means follows that the presence of acetylene in the interior of a flame must give rise to a luminous flame, as there are two factors to be satisfied before luminosity is attained. The first is that acetylene, or hydrocarbons capable of being converted into acetylene, should be present; and the second, which is of equal importance, is that the temperature should be sufficiently high to cause the rapid decomposition of the acetylene.

It is perfectly possible for the temperature of a flame to be so little above the point necessary to decompose the diluted acetylene that, while some decomposes and renders the flame faintly luminous, the larger portion burns without decomposition. A good example of this is to be found in the combustion of alcohol, the flame of which contains as much acetylene as is to be found in a good coal-gas flame, but which is practically almost non-luminous. If alcohol in a small dish be ignited, it burns with a faintly luminous flame; and if a bell-jar is placed over it, some of the products of combustion mingling with the flame still further cool it, and render it non-luminous. But if a stream of oxygen is introduced under the bell-jar, the temperat ure of the flame is at once increased, and becomes highly luminous, while a cold porcelain vessel held in the flame is coated with soot.

The temperature necessary to bring about the conversion of hydrocarbons into acetylene is but little affected by dilution, as it is chiefly radiant heat which is acting; but dilution plays a most important part in increasing the temperature needed to cause the luminous decomposition of the acetylene. This can be clearly shown by the experiment of passing acetylene through a heated glass tube into which a thermo-couple has been fitted, so that the temperature required for bringing about luminous decomposition can be measured. All air having been removed by a current of the mixture to be experimented with, the gas is allowed to pass at a steady rate of flow through the tube; the point at which the thermo-couple is situated being steadily heated by a Fletcher blowpipe, while the temperature recorded on the scale is noted the moment that incandescent liberation of the carbon commences:—

Percentage Composition of Gas.			Temperature Necessary to Cause Decomposition of Carbon with Luminosity.
Acetylene.		Hydrogen.	
100	..	0	.. 780°C.
90	..	10	.. 896
80	..	20	.. 1000

It was found impossible to obtain a glass tube which would stand temperatures higher than this. But on plotting out the points so obtained, and which gave a fairly straight line, it is seen that, even if the increase in temperature only continues for increased dilution in the same ratio as shown in the experimental determinations (which is extremely unlikely), the reason of the destruction of luminosity in highly-diluted hydrocarbon gases is at once explained, as an increase of each 10 per cent. in the dilution would necessitate an increase of 100° C. in the temperature of the flame, and with 90 per cent. dilution a temperature of above 1700° C. would be required to bring about decomposition.



Temperature required to decompose Acetylene with Separation of Luminous Carbon.

My reason for believing that it is highly improbable that, when dilution is great, it only requires the same increment in temperature to bring about decomposition as when the dilution is small, is that, in all the work I have done on the effects of diluents on luminosity, and also in Professor Frankland's researches upon the same subject, dilution with hydrogen and carbon monoxide acts regularly, and decreases the value of the illuminant in a direct ratio down to about 50 per cent.; while when the degree of dilution exceeds 60 per cent., a rapid falling away in the luminosity takes place—a fact which, I think, points clearly to a regular *pro ratâ* rise of temperature being needed for increase in dilution up to between 50 and 60 per cent., while higher degrees of dilution need a far greater rise of temperature in order to bring about decomposition.

When a simple hydrocarbon like ethylene or acetylene is burnt alone, the whole of the heat required to bring about the decomposition is generated by the combustion, without decomposition, of a considerable proportion of the hydrocarbon. This means very large dilution at the spot where the luminosity commences; so that at the top of the non-luminous zone of an acetylene flame, there is only some 14 or 15 per cent. of acetylene present diluted with nitrogen, hydrogen, water vapour, and the oxides of carbon.

It is manifest that the luminosity of a flame will be governed, not by the percentage of acetylene in the gas, but at the point at which the temperature is sufficiently high to bring about decomposition. In order to see if the percentage of acetylene present at the top of the non-luminous zone bore any ratio to the illuminating value of the mixture, experiments were made in which mixtures of hydrogen and acetylene were burnt at a small flat-flame burner; and the percentage of acetylene was determined by gently aspirating out some of the flame gases from the top of the non-luminous zone—

Analysis of Mixture.			Acetylene at Top of Non-Luminous Zone.		Illuminating Value of Flame for 5 Cub. Ft.
Hydrogen.		Acetylene.			
65·5	..	34·5	3·72	..	14·0
43·5	..	56·5	8·42	..	87·0
0·0	..	100·0	14·95	..	240·0

These results certainly seem to point to the fact that,

with flames of the same size burning from the same burner, the light emitted by the flame is directly proportional to the percentage of acetylene present at the top of the non-luminous zone of the flame, provided always that the temperature is sufficiently high to complete its decomposition.

The theory I have tried to develop to you explains many points which the older ideas did not satisfactorily explain. It shows us why dilution with gases incapable of conversion into acetylene renders a gas-flame non-luminous; and we also find in it an explanation of why it is that gases —ethane, ethylene, and acetylene—though containing the same number of carbon atoms in the molecule, give such widely different illuminating values. It also makes clearer the anomalies which have beset our path in the study of enrichment values. Much has yet to be done before the precise amount of luminosity due to this action is determined. But I am convinced that this phenomenon, and the chemical changes leading to it, will be found to be the chief cause of luminosity in flame.

I have continued the work; and, though the experimental details are not yet ready for publication, I find that the main actions going on in a luminous flame may be described as follows: As the gas leaves the burner, those portions which come in contact with the air enter into chemical combination with the oxygen of the air, and give a film of flame in which the hydrocarbons, owing to dilution, are burnt, without any preliminary decomposition, into carbon and hydrogen; the temperature of this film varying according to whether the hydrocarbon is endothermic or exothermic. Acetylene, for instance, gives an intensely hot flame, owing to the heat evolved being the temperature of its combustion *plus* the thermal units due to its endothermicity; while ethane would give a much cooler flame, as so much heat would be absorbed in its decomposition—*i.e.*, much more ethane would be consumed to give a certain temperature than would be the case with acetylene.

When the illuminating gas is a mixture like coal gas, the lighter the constituents are, the more rapidly will they diffuse, and so reach the outside of the flame. The result of this is that the hydrogen and the methane are the first to burn; and the heavier hydrocarbons, flowing upwards between the walls of flame, become highly heated and converted into a mixture of acetylene and methane.

Taking ethylene as the type of the unsaturated hydrocarbons present in the gas, the change would be represented by—

$$\underset{\text{Ethylene.}}{3C_2H_4} = \underset{\text{Acetylene.}}{2C_2H_2} + \underset{\text{Methane.}}{2CH_4}$$

and at the top of the inner non-luminous zone, 80 per cent. of the unsaturated hydrocarbons present are found to be acetylene. The temperature of the flame rapidly rises the higher the point; and at the spot where the luminosity of the flame commences, the temperature is upwards of 1000° C. This causes sudden and extremely rapid decomposition of the acetylene into its constituents—

$$\underset{\text{Acetylene.}}{C_2H_2} = \underset{\text{Hydrogen.}}{H_2} + \underset{\text{Carbon.}}{C_2}$$

The heat thus liberated, having no time to dissipate itself among the other gases present, heats up the carbon particles to a temperature far higher than the average temperature of the flame—causing them to become incandescent, and so render the flame luminous; the incandescence of these solid particles being further aided by the temperature of the flame and by their own combustion, partly by the oxygen of the air, and partly by the action of water vapour and carbon dioxide upon them—

$$(a)\quad \underset{\text{Carbon.}}{C} + \underset{\text{Oxygen.}}{O} = \underset{\text{Carbon Monoxide.}}{CO}$$

$$(b)\quad \underset{\text{Carbon.}}{C} + \underset{\text{Water Vapour.}}{H_2O} = \underset{\text{Carbon Monoxide.}}{CO} + \underset{\text{Hydrogen.}}{H_2}$$

$$(c)\quad \underset{\text{Carbon.}}{C} + \underset{\text{Carbon Dioxide.}}{CO_2} = \underset{\text{Carbon Monoxide.}}{2CO}$$

It is the combustion of the carbon monoxide and hydrogen so formed which gives the upper portion of the outer non-luminous envelope to the flame. The small blue portion of the outer envelope at the base of the flame is caused by the rapid inrush of air—the nitrogen so diluting the hydrocarbon molecules at that point that they are burnt up without being first decomposed. There being, therefore, no separation of carbon, there is no luminosity. The same blue colour may be observed when a gas-flame is rendered non-luminous by dilution either with nitrogen or carbon dioxide.

Beyond this point, we cannot at present go; but I hope the considerations I have brought before you this morning will awaken new lines of thought in your minds, and that even if you are not at present willing to adopt the theory that I have tried to make clear to you, you will not condemn it until those gentlemen who profess antagonism to it have some feasible experimental evidence to offer against it.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1332.)

Business in the Stock Exchange was far from being violently active last week, and the great boom has not arrived yet; but still it was a good week with a good tendency. In every department, there was a marked advance in prices, from the choicest of the gilt-edged luxuries to the most speculative; and perhaps these two extremes achieved the greatest advances. On the one hand, an enormous quantity of money, which must go somewhere, keeps pouring into the solid investment stocks; while, on the other, the attractions of mining adventures suffer no diminution. As for the Money Market, it is hardly too much to say that money well secured can now be had on almost any terms. While the position of the markets in general was thus favourable, it is no wonder that prices in the Gas Market continue steadily to push their way up. Business there was not very brisk; and it grew much quieter as the week proceeded. But there is not much of the best stocks coming into the market. Gaslight "A" was the least in favour; and it opened at a reduction of one point, from which it did not recover by the close. Next to nothing was done in the secured issues; but it would not have taken much to send them up. As it is, the debenture stocks are quoted *ex div.* at nice advances. Hardly any business was done in South Metropolitans for lack of sellers; but a parcel of "B" changed hands on Saturday at a level 300. Nothing whatever was marked in Commercials; but the debenture stock was put up a little higher. In the Suburban and Provincial division, there were a few bargains; almost everything commanding better figures. Brentfords are up again; and Bristol nearly touched a 4 per cent. price. The Continentals did well. Imperial recovered its old quotation; and Unions improved upon theirs, while European marked top price repeatedly. Among the rest, Melbourne bonds had a further rise; and Monte Video and Buenos Ayres were strong. In Water, the notable incident of the week has been the failure of the London County Council to get their new views on arbitration through the Commons' Committee-room. So the Companies breathe once more; and their stocks jumped up to the extraordinary figures shown in the list on page 1332.

The daily operations were: The opening day was quite devoid of animation; but prices held good, except for Gaslight "A," which fell 1. Each Brentford issue, however, advanced 2. In Water, New River debenture rose 1½. Business was more active on Tuesday. Melbourne bonds rose 1. Lambeth Water advanced 2. Transactions on Wednesday were still very limited; but several quotations rose *ex div.* East London Water improved 1. On Thursday, business was almost stagnant. Gas quotations did not move; but there was a great advance in Water. East London rose 8; Lambeth, 7½; Chelsea, New River, and West Middlesex, 5 each; Grand Junction and Kent, 3 each; and Southwark, 2. Gas continued very inactive on Friday; but Bristol and Continental Union advanced 2 each; and Melbourne bonds, 1. In Water, Southwark rose 7½ more; Lambeth, 5; ditto, 7½ per cents., 2½; and West Middlesex, 4½. Saturday exhibited the usual quietude; but further advances were scored in Water. Lambeth, New River, and Southwark improved 5 each; and Chelsea, 2½.

The Opposition to the London Water (Transfer) Bills.—The opposition of the outside authorities to the London Water (Transfer) Bills will, it has been arranged, be mainly left to the County Councils of Middlesex, Hertfordshire, Kent, and Essex, who will be represented before the Committee of the House of Commons by Mr. Pember, Q.C., Mr. Clarke Williams, Lord Robert Cecil, and Mr. C. H. Richards. The Surrey County Council, though they have come to an agreement with the London County Council, have instructed Mr. Lewis Coward to watch the proceedings on their behalf; but the District Councils of Acton, Barking, Bromley, Buckhurst Hill, Dartford, East Ham, Erith, Hornsey, Ilford, Sevenoaks, Walthamstow, Wanstead, and Woodford will not support their opposing petitions by Counsel, but will rely upon their respective County Councils to place their cases before the Committee. The Corporations of West Ham and Kingston-upon-Thames, and the District Councils of Wimbledon and Croydon (Rural) have not at present instructed Counsel to appear on their behalf; but they reserve their right to do so before the proceedings terminate.

NOTES.

An Apology for London Fogs.

The smoky London atmosphere is discussed in a recent issue of *Nature* by Mrs. G. C. Frankland from a quite novel standpoint. After describing the character and results of certain experiments carried out by Dr. Masella and others, with the object of ascertaining the effect of exposure to sunshine of animals infected with specific diseases, Mrs. Frankland sums up the evidence by stating that, while exposure to sunshine seems to be beneficial to sufferers from tuberculosis, it appears that the greater prevalence and virulence of typhoid and cholera in hot countries is attributable to the hot and continuous sunshine. "After all," says Mrs. Frankland, "our smoke-laden atmosphere and dreary yellow fogs may be turned to account seemingly; and the London Water Companies may congratulate themselves that these two water-borne diseases *par excellence*, may be made to yield not only to efficient purifying processes at their hands, but that such an unexpected ally, according to Dr. Masella, is to be found in the limited amount of sunshine which Londoners can enjoy." It follows, however, that if one hypothesis is to be accepted, the other should not be ignored; and consequently an increased deadliness of tuberculosis should be set off against atmospheric protection from typhoid and cholera.

Materials for Constructing Large Water-Mains.

In connection with the extensions of the Brooklyn (New York) Water-Works, it was desired to make a pipe-line of considerable length; and before any definite design was adopted for this aqueduct, Mr. I. M. de Verona was requested to report on the comparative merits of cast-iron, wrought-iron, and steel pipe. The report pronounced in favour of riveted steel pipe, which was eventually selected. On account of the interest of the report, it has been incorporated in the "Proceedings" of the American Society of Civil Engineers for 1894. Mr. de Verona had to deal with a question of some 5 or 6 feet of piping; and while certain foundries offered to cast such pipe, nobody recommended it. Fifteen miles of such pipe seemed a risky experiment; and to use a double line meant a great deal more expense than the estimated cost of a single 5 feet riveted steel main. In discussing the respective merits of wrought-iron and steel riveted pipe, the first point to be considered is that of comparative durability, assuming the ultimate destruction of the protective coating; and the report gives an interesting summary of the available information upon this subject. This was so contradictory that Mr. de Verona made some experiments himself with the different materials proposed to be employed. He found that a good deal of experimenting will be required before any really scientific statement of the comparative liability of different kinds of iron and steel to corrosion can be made. For practical purposes, however, a decision on the point can be arrived at, especially as there are other considerations to be regarded. Even if it be admitted that wrought iron plates may offer in some cases a somewhat greater resistance than steel plates to corrosion from potable water, it does not seem that the difference would be great. Moreover, steel is so much cheaper for the purpose than wrought iron that the difference in cost will more than balance any probable difference in ultimate resistance to oxidation. Lastly, the facilities for carrying out a large pipe-line contract in steel are much greater than obtain with wrought iron.

Artificial White Daylight.

Captain Abney, F.R.S., has told in a Society of Arts paper how he has succeeded in preparing, for the lighting of picture galleries, an artificial kind of daylight, warranted not to fade pictures one-tenth as fast as natural daylight is capable of doing it. The author referred to the report which (in conjunction with Dr. Russell) he made to Parliament in 1888 upon the causes of the fading of pigments from exposure to light. It was stated in this report that the rays which produce by far the greatest change in a pigment are the blue and violet components of white light; and that these, for equal illumination, predominate in light from the sky. They are however least in sunlight and in diffused cloudlight, and are present in comparatively small proportions in the artificial lights usually employed in lighting a room or gallery. The first idea was to correct natural white light by glazing the skylight with yellow glass. But this suggestion was rejected, because although it would protect pigments, it would give such a tinted light that would prevent the blues from being properly seen. The outcome of Captain Abney's studies of the subject was the project to cut off the violet rays from natural white light without altering the colour. This apparently problematical idea has been successfully carried out in the lighting of the Raphael Cartoon Gallery at South Kensington, where the daylight is filtered through two coloured glasses, one a blue-green and one yellow—the combination resulting in a white light which is a very close match to that of electric light, rendering the blue pigments exposed to it a little more brilliantly than they would appear by natural daylight. There is a loss of 65 per cent. of light; but where the skylight is large enough, this does not matter, especially as the necessity for a blind or for ground glass is done away with. Captain Abney's discovery explains why the light that passes through blue and yellow stained glass windows is white and of a particularly soft effect.

Suggestions in Calorimetry.

Writing to *Nature* respecting Dr. Joly's proposal to change the unit of heat, Mr. Spencer Pickering observes that Dr. Joly's strictures upon the units at present in use will meet with a ready endorsement by those who have worked on calorimetry. The large calorie is too large for convenience in most cases; and the small calorie is too small. The confusion, too, created by different writers using different units of the same name is scarcely reduced by their writing one of them with a capital and the other with a small initial letter. A unit of convenient magnitude would be one equivalent to about 100 small calories; and 100 calories has, indeed, been adopted as a unit by more than one writer on thermo-chemistry. Mr. Pickering proposes instead of this a natural quantity which is nearly equivalent to such a unit—namely, the heat of fusion on one gram of water at 0°C., which is nearly eighty calories. This he thinks just as suitable from other points of view as the heat of vaporization of one gram of water at constant temperature and 760 millimetres pressure; and if the latter can be recommended on the ground that, in defining it, we replace the thermometer by the barometer, the former will possess the superior claim of not depending even on the barometer. To this suggestion Dr. Joly raises the objection that the latent heat of water unit is an inaccessible unit, by reason of the difficulties attending measurements with the Bunsen calorimeter. He refers to certain experiments of his own with a gravimetric ice calorimeter, which were encouraging; and he admits that there is much to be said for a thermo-dynamic unit. It is desired that the opinions and views of men of science should be expressed upon the subject.

COMMUNICATED ARTICLE.

NOTES ON LUMINOUS AND NON-LUMINOUS COMBUSTION.

By B. H. Thwaite.

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Nearly half a century has elapsed since the most illustrious of our past great scientific experimental investigators—Michael Faraday—used to delight his audience at the Royal Institution, not only by the simplicity and originality of his experimental demonstrations, but also by the lucidity of his verbal description of the phenomena associated with chemical and electrical energy. The theory that Faraday enunciated in his lectures to explain the cause of luminosity of combustion was that introduced by his brilliant predecessor, Sir Humphry Davy. This theory was accepted by the author, in the absence of direct experiment proving it to be wrong. It has now been challenged by Professor Harold B. Dixon, F.R.S. (*ante*, p. 214).* It is only by critical analysis that one finds out the truth; and therefore we are indebted to Professor Dixon for raising an interesting inquiry.

Modern chemists and physicists have generally accepted the Davy-Faradaic theory. Amongst them may be mentioned: Soret, the first to optically establish, by experimental proof, the fact that the luminous portion of an ordinary batswing or Argand flame is solid; Mees, who developed Soret's method of proof; also Hirn, Knapp, Heumann, and Wulner; Berthelot, whose experimental researches into the domain of thermo-physics are beyond praise—and whose magnificent work, "Essais de Mécanique Chimique"—is a monument of enduring fame, to the honour and glory of French science; and Mendeléef. All these accept, more or less in its entirety, what we will call, for brevity and distinction, the Davy-Faradaic theory. Subject to certain qualifications, the author still believes, and hopes to be able to prove, this theory to be sound, and far more nearly allied to the exact truth, than the one now held by Professor Dixon, based as that gentleman's theory is, upon experience of combustion phenomenon that has little in common with the open or unrestrained, or free and sequential character of combustion at atmospheric pressures.

The author's first article, in which certain conclusions are challenged, was intended to show that the luminous combustion of gas burnt *à la* Welsbach, or in such a way that the heat of combustion of the hydrogen and the carbon is transmitted to a refractory and inoxidizable medium, is very greatly superior to the luminous efficiency of the combustion of gas burnt (say) in an ordinary batswing burner, in which the luminosity is based on the incandescence of the carbon resulting from the combustion of the hydrogen. Described with more detail, both these methods of combustion involve, as necessary qualifications—

(1) That the combustion of the hydrocarbonaceous gas shall be gradual.
(2) That the gas shall flow during combustion from an orifice at a certain pressure.
(3) That this pressure shall be a little above that of the atmosphere.
(4) That the combustion itself shall be effected at the pressure of the atmosphere.

The conditions of combustion now under comparison do not

* The present article, which is a reply to Professor Dixon, was prepared by Mr. Thwaite some time ago; but we have been compelled to hold it over.—Ed. J.G.L.

include one that would be subordinate to any of the following qualifications:—

(A) The preadmixture of the hydrocarbonaceous gas and air in explosive proportions.

(B) The enclosure of such gases in a closed vessel before and after combustion.

(C) Neither does it permit the inclusion of a condition that permits the combustion of the hydrocarbonaceous combustible, *ab initio* in a solid form, as distinct from a combustible of a gaseous character.

It is thought necessary to make these specific and fundamental distinctions, because the characteristic of the combustion and the conditions that would apply to one form of combustible and method of its oxidation, do not altogether, if at all, apply to those of another. To raise objections (based on a knowledge of one, and a distinctive, method of combustion, and involving certain conditions) to theories that are only intended to apply to quite distinctive methods of combustion, is obviously untenable. As evidence of the importance of this distinction, it is quite clear that a combustion effected according to the formula given by Professor Dixon for the combustion of acetylene and ethylene, and producing carbon monoxide, could not produce a very luminously explosive combustion; and such an equation has little resemblance to one representing the action of the methods of combustion which are the subject of this and former memoirs presented by the author.

Divested of irrelevant comparisons, Professor Dixon's article merely contains references to certain laboratory experiments of Professor Smithells, to substantiate the *rationale* of his other objections. Here, again, we have a distinctive form of combustion—this time *à la* Argand. The meaning of the results in Professor Smithells's investigations is not at all conclusive. Even Professor Dixon, to use his own words, admits "it is conceivable that the hydrogen burns first." So that he may be said to have failed, in his article, to advance any experimental proof to upset the Davy-Faradaic theory.

As both Berthelot's results, and the others referred to, bear more directly upon the subject under discussion, if we are to be guided by experiment, and not by imagination, we are bound to admit that the Davy-Faradaic theory, explaining the phenomenon of a hydrocarbon gas-flame burning at the pressure of the atmosphere, is true to nature, and is not a fallacy, except so far as it includes, by Davy's stated qualification to his original theory the suggestion that the oxidation of the solid carbon following on that of the hydrogen adds by its heat to the luminous intensity to any appreciable degree.

Influence of Thermolysis.

The author's experience in the use of hydrocarbonaceous fuels—solid, liquid, and gaseous—has satisfied him that the stability of nearly all the hydrocarbons is destroyed when brought under the influence of temperatures above 2000° Fahr. This thermic influence induces hydrocarbon decomposition, which we will call "thermolysis," or the splitting up by heat of hydrocarbon compounds. This thermolytic action is a part of the explanation of the sequence of action of ordinary carbon luminous combustion.

The oxidation of the free hydrogen as well as of part of the hydrogen of the decomposed hydrocarbons, establishes a zone of high temperature. In this zone the hydrocarbon structure, still undecomposed, collapses; and both the hydrogen and the carbon are set free. The hydrogen is oxidized to water vapour; and the carbon, if there is oxygen present, is oxidized to carbon monoxide, or, if oxygen is not present in equivalent proportions, is set free as a solid and in a highly incandescent condition—providing the luminous proportion of the flame.

The influence of this thermolytic action is well known. The author has shown elsewhere that, owing to this influence, the principle of preheating gaseous fuel, employed in the Siemens form of furnace, is bad, because the exposure of the hydrocarbon gas to the influence of highly-heated bricks tends to throw down the carbon part of the hydrocarbon into the recuperator chamber, and a great part of the thermic assets of the fuel is thus lost. The same action of thermolysis occurs in the production of enriched water gas. If the fixing chambers are too hot, the hydrocarbons are thermolytically decomposed, and the lighting value of the gas is seriously impoverished.

The formula of complete thermolysis, applied to one of the simple hydrocarbons, may be thus expressed:

$$C_2H_6 + \text{thermolytic influence} = 2\,C + 6\,H;$$

the former being deposited in a solid, while the latter is in a gaseous condition.

$$\text{Marsh Gas } (CH_4) + \text{thermolytic influence} = CH_4 = C + 4\,H.$$

Acetylene exposed to only a relatively high temperature is decomposed into marsh gas and free carbon thus:

$$C_2H_4 + \text{thermolytic influence} = CH_4 + C.$$

The heat-absorption involved in the act of thermolytically separating a given weight of hydrocarbon is the same whether the two elements, hydrogen and carbon, are oxidized simultaneously or in sequence. The object of the author's preceding article was intended to show a comparison of efficiency between two methods of combustion; and he decided to neglect those factors on each side of the comparative equations, which were the same for both systems of combustion, especially in the face of the uncertainty of the correcting factors.

It is well known that the difference between the heat of combustion for marsh gas (C_2H_4) first calculated separately, and secondly as actually obtained in the calorimeter, is 21·75 : 24·75; whereas olefiant gas, whether calculated separately or burnt in a calorimeter, is the same—proving there is a physical difference between the form of carbon in the one and in the other.

The author notices that Professor Dixon semi-apologetically refers to the purposely omitted correction for the absorption of heat in the thermolysis of the hydrocarbon, and its influence on the total heat produced when compared with the burning of the two elements separately.

The Influence of the Heat from the Oxidation of the Carbon on its Non-Luminous Intensity.

The argument advanced by both Professor Dixon and Mr. Young—that part of the heat of the combustion of the carbon burnt to carbon dioxide should be credited as assisting to build up the degree of incandescence of the carbon part of the flame—is not reasonable. A stream of atoms of incandescent carbon meet equivalent atoms of oxygen; the result being the annihilation of the solid character forming the basis of incandescence, and its displacement by a gaseous and non-luminous product. Any heat of a sensible kind associated with the gaseous products of combustion ascends above the zone of action as rapidly as the cold air rises to supply the carbon with its equivalent oxygen.

Here is an argument proving the fallacy of Professor Dixon's suggested correction: Immediately a light is applied to lighting gas, it illuminates instantly with its full and mature measure of light. Did it not do so, then Professor Dixon might, with some support, suggest that part of the heat resulting from the oxidation of the carbon is, in some inexplicable way, transferred to atoms of carbons following the *disappearance* of those atoms immediately preceding, and which have disappeared as a result of their oxidation to carbon dioxide—a colourless gas.

In the combustion of a carbonaceous solid, we have an aggregation of atoms attached to each other, not like the atoms of carbon that are separated from the hydrogen zone of oxidation of a gas-flame. When carbon atoms are aggregated together, the heat resulting from the oxidation of one atom is communicated to its immediate associates, until it is transferred more or less to the entire mass. It will perhaps be conceded that the carbon incandescence of (luminous) gas combustion is not, in any appreciable degree, due to the oxidation of the carbon, in the absence of positive data to the contrary.

Luminous Hydrocarbon Flame Combustion involves the Reactions common to Water-Gas Production.

The argument raised by Professor Dixon that, if the Davy-Faradaic theory is correct, it would involve the production of water gas, is accepted as true to a certain extent; and if Professor Dixon will accept the results to be given farther on as proving the existence of the action of water-gas production, he will then be compelled to acknowledge that the Davy-Faradaic theory is correct.

We will define the equation of water-gas production thus:

$$\textit{1st action:}\ 4\,(H_2O) + 2\,C = 2\,CO_2 + 8\,H$$

$$\textit{2nd action:}\ 2\,CO_2 + 8\,H + 2\,C = 4\,CO + 8\,H.$$

In the combustion of a hydrocarbonaceous gas, the action of combustion may be thus sequentially described:

(A) Free hydrogen oxidized.

(B) Part of proportion of higher hydrocarbons thermolytically decomposed.

(C) The water vapour resulting from the oxidation of the free hydrogen (A) in contact with the incandescent carbon (B) results in the formation of carbon monoxide and the freeing of the hydrogen.

(D) The complete decomposition of the remainder of the hydrocarbons; the hydrogen burning, and the carbon being set free in an atomized and incandescent condition.

(E) The incandescent carbon is either brought into contact with air or with the water resulting from the oxidation of the hydrogen; producing in the former instance carbon dioxide, and in the latter the carbon monoxide compound. If there is an excess of air, the latter gas is oxidized to carbon dioxide.

Granting that this stated sequence of action is true to nature (and M. Landolt's results leave little doubt on this point), we have the superior value of combustion, effected *à la* Bunsen, absolutely confirmed.

It may be argued that the partial oxidation of the carbon of the hydrocarbons to carbon monoxide would provide a certain proportion of heat in the non-luminous zone; but the maximum temperature that could result from this merely partial carbon oxidation would not raise to incandescence (of any luminous value) any atoms of unoxidized carbon passing through the zone of such carbon monoxidation. Every atom of carbon so oxidized takes away from the carbon density of the flame.

The author, assisted by Mr. Horace Allen, has made some experiments to discover the ratio of carbon deposition to the total carbon in ordinary naked flame combustion. From these experiments, he deduced the fact that only a certain and varying proportion of the carbon was utilized in any hydrocarbon batswing or similar flame in incandescence light giving. It may be stated that not more than 30 per cent. of the original carbon

assets of a hydrocarbonaceous flame are deposited in the luminous area of the flame; the remaining part of the carbon—burning to carbon monoxide, and afterwards to carbon dioxide—clearly provides no illuminating value, because the carbon in a solid form, to which the heat might be given, disappears on the oxidation to either carbon monoxide or carbon dioxide, both gases having no luminous value. Whereas the complete oxidation of the carbon to carbon dioxide in combustion effected *à la* Welsbach or equivalent system, and the inoxidizable network to which such heat is transmitted, permits the full utilization of the heat; and as the carbon is instantly oxidized to carbon dioxide, the water gas reactions occurring in ordinary flame combustion cannot take place.

The Restricted Efficiency of Recuperative Combustion.

The fact of the partial oxidation of the carbon of the hydrocarbons adds to the value of the recuperative principle, because, although the carbon, oxidized to carbon monoxide and then to carbon dioxide, gives no luminosity in itself, the heat resulting from its oxidation is partially transmitted in a sensible form to the air flowing to support combustion. The heat thus supplied is added to that produced by the oxidation of the hydrogen, and a higher degree of luminosity is the consequence. Unfortunately, no form of recuperator can give a perfect return of the heat introduced into it—a great portion being lost through the chimney; and this is why the recuperator lamp is inferior in light-giving efficiency to the incandescence lamp of the Welsbach type.

Landolt's Results Tabularly Expressed.

	Height in Millimetres at which the Gas Tested was Aspirated above Emission-Point in Ordinary Burner, of 0·007 mm. Diameter.	Volumetric Proportions shown graphically by figures 1 and 2. H.	CO.	CO_2.	N.	O.	C_4H_8.	C_2H_4.	CH_4.	H_2O.
		%	%	%	%	%	%	%	%	%
A	50	2·59	5·45	7·01	66·59	..	0·58	0·60	0·79	16·39
A	40	3·43	5·26	5·62	64·01	..	0·77	0·90	2·82	17·19
A	30	4·99	4·68	4·81	59·18	..	1·00	1·55	6·92	16·87
A	20	2·23	5·71	4·11	57·25	0·19	1·34	1·86	11·52	15·79
B	10	12·45	9·71	1·95	32·20	0·65	2·65	3·59	25·14	9·66
B	0	20·34	6·59	1·74	26·40	0·59	2·75	3·80	30·31	7·48

A Luminous. B Non-luminous.

Remarks.—The analytical tests made by the author and Mr. Allen confirm the fact here shown, that practically *no carbon dioxide* is produced in a height of 15 millimetres of the non-luminous zone. *Vide Addendum.*

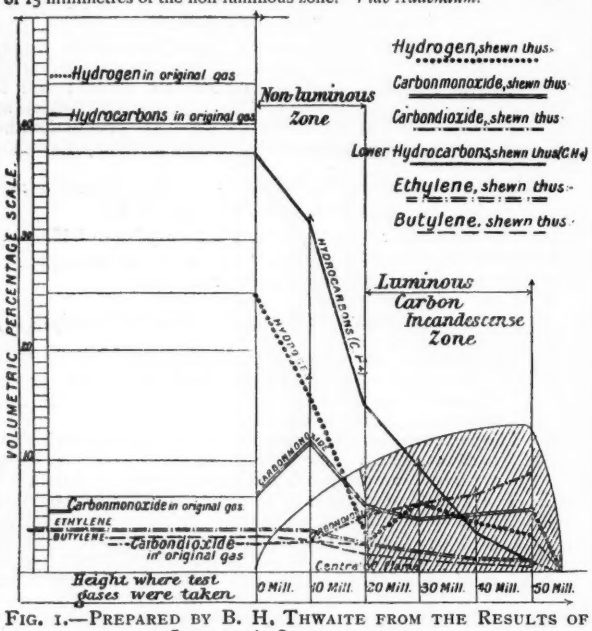


FIG. 1.—PREPARED BY B. H. THWAITE FROM THE RESULTS OF LANDOLT'S INVESTIGATIONS.

Landolt's results, given tabularly and presented graphically, appear to show that, in the combustion of a hydrocarbonaceous gas, in an ordinary batswing burner—

(1) The hydrogen is oxidized before the carbon.
(2) The combustion of the hydrogen produces the heat by which the hydrocarbons are thermolytically decomposed.
(3) The thermolytic action proceeds progressively.
(4) Part of the carbon of the decomposed hydrocarbon is partially oxidized to carbon monoxide, but not to carbon dioxide.
(5) The hydrogen is oxidized to water, and is partly reduced to hydrogen by the carbon, but is eventually re-oxidized to water.
(6) Only a portion of the carbon is liberated in a free and incandescent condition, to form the luminous portion of a flame.

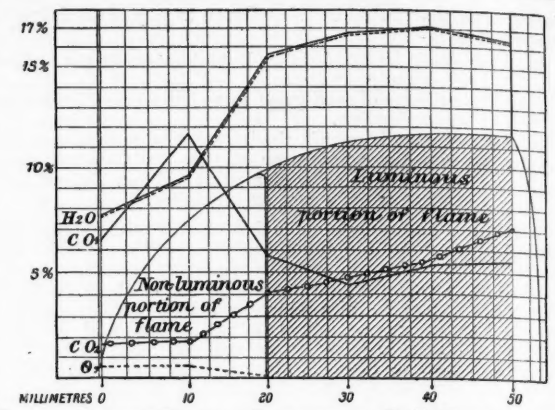
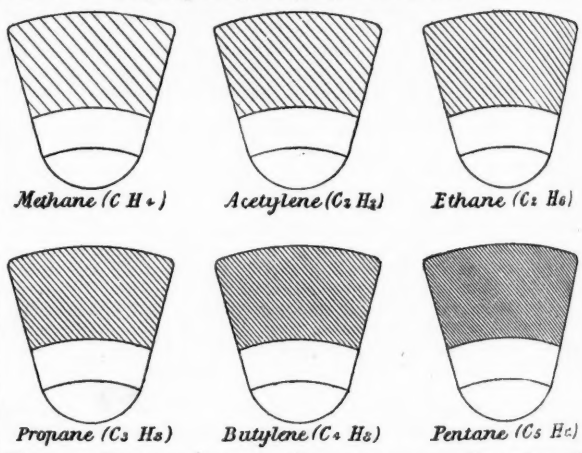


FIG. 2.—GRAPHIC DIAGRAM PREPARED BY B. H. THWAITE FROM THE RESULTS OF LANDOLT'S INVESTIGATIONS.

Influence of Flame Juxtaposition.

The explanation of the fact that two luminous carbon flames placed in juxtaposition give a rather higher photometric efficiency than a single flame, is probably as follows: The flow of atoms, in rapid vertical movement, makes the flame surface more dense. The interspace between one atom and another in one flame may, in another closely adjoining and parallel flame, have a corresponding atom-filled space; and the luminous radiation may be considered to be equivalent in intensity to an area of luminosity of twice the density of the single flame. The same principle partly applies to the Argand method of combustion. There is this objection, that part of the luminous rays from the two parallel and inner faces may be absorbed by the atoms of carbon. But this degree of radiant and luminous loss must be small, because the flow of the carbon in atomized form may be taken to be equal to the velocity of the gas emitted from the burner orifice; and this velocity compared with that of light is as 1 : 3,000,000.

The more dense a given hydrocarbon, the more concentrated is its luminous emitting surface. If our optic nerves were sufficiently sensitive, we should be able to discern the intervals between the atoms of carbon as they emerge from the zone of hydro-oxidation. We, however, realize the increased luminosity due to the increase in the number of carbon atoms by the superior luminosity of the higher hydrocarbons. The author has already graphically shown the effect on thermo-luminous action and efficiency of increased molecular density of the hydrocarbons. The group of figures (fig. 3) is intended to demonstrate



FIGS. 3.—DIAGRAM SHOWING GRAPHICALLY THE DENSITIES OF SOME HYDROCARBONS.

graphically the greater intensity of surface luminosity of different hydrocarbons, and is an attempt to show the exact influence of increased molecular density by shaded surfaces. The density and corresponding luminous efficiency is the measure of the deepness of the hatched surface, which represents the luminous portion of the flame.

ADDENDUM.

The author, in conjunction with Mr. Horace Allen, made a few determinations to ascertain whether the carbon in the London retort gas, either in association with hydrogen as hydrocarbon or with oxygen as carbon monoxide, was oxidized, in the non-luminous part of the flame, to carbon dioxide. In the test, when employing the ordinary jet or batswing flame character of flame combustion, a No. 8 Sugg's burner was employed. The gas was burnt at the ordinary pressure employed by The Gaslight and Coke Company; and the gas was taken from the identical main from which the gas was obtained for the gas-engine tests that were referred to in the last article

contributed by the author.* In aspiring the gas (products of combustion), great care was exercised that it should be truly representative, and that only the products of combustion would be included.

In the first two tests, identified as determinations A and B, the flame was of the shape shown in fig. 4. In the A

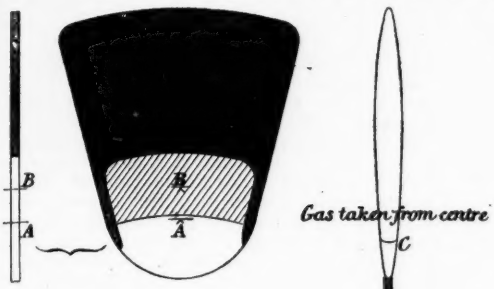


FIG. 4.—GASES DRAWN OFF AT POINTS A, B, AND C.

FIG. 5.

determinations, the gas was aspired from the flame at the level marked by the letter A in fig. 4, or at a height of $\frac{3}{4}$ inch above the burner tip in the non-luminous zone. In the B determination, the gas was drawn at a height of 1 inch above the burner tip, and at the point marked B, just within the zone of non-luminous combustion, and on the margin of the luminous portion of combustion.

Percentage of Volumetric Carbon Dioxide.	Actual Percentage of Total Carbon Oxidized to Carbon Dioxide, less Original Proportion contained in the Gas (0·5 per Cent.)	Percentage Proportion remaining to be Oxidized in Luminous Part of Flame.
A Determination, 0·8 per cent. Proportion due to combustion equals (0·8—0·5) 0·3 per cent.	3·6 per cent. ..	96·4 per cent.
B Determination, 2·0 per cent Proportion due to combustion equals (2·0—0·5) 1·5 per cent.	23·8 „ ..	76·2 „

The proportion of carbon dioxide that should be found if all the carbon were oxidized to CO_2 with the atmospheric equivalent, is taken as being equal to 8·3 per cent.

In the C determination, the batswing (No. 8) burner was removed, and the gas was allowed to flow quite freely from a pipe of $\frac{1}{8}$ inch bore, when the combustion assumed the form shown in fig. 5. The products of combustion were drawn from the flame at the point C, or at a height of $1\frac{7}{8}$ inches above the burner.

Percentage of Volumetric Carbon Dioxide.	Actual Percentage of Total Carbon Oxidized to Carbon Dioxide, less Original Proportion contained in the Gas (0·5 per Cent.).	Percentage Proportion remaining to be Oxidized in Luminous Part of Flame.
C Determination, 2 per cent. .	23·8 per cent. ..	76·2 per cent.

These results confirm those of Landolt, and show that, on the decomposition of the hydrocarbons by thermolysis, the carbon is either oxidized to carbon monoxide, or is deposited as solid carbon to form, in its incandescent state, the luminous portion of the flame. It will be fully recognized that the partial oxidation of the carbon to carbon monoxide, instead of aiding or adding to the degree of luminous energy of flame combustion, actually detracts from, and reduces it. The disadvantage of association between incandescent carbon, producing carbon monoxide by the equation $CO_2 + C = 2\ CO$, is removed in a method of combustion such as is the Welsbach or equivalent system, in which the luminous part can neither (under the conditions established) oxidize nor dioxidize. Hence the value of the Welsbach or other similar system, in which the incandescent agent neither reduces the carbon dioxide, nor becomes converted into gas by its own oxidation.

Adhesion of Cement to Brickwork.—In the JOURNAL for Jan. 22 last (p. 167), we gave particulars of some tests carried out by M. Félix de Walque upon the adhesion of cement mortars to brickwork. Further experiments have been made by Messrs. L. J. Affelder and R. C. Brown, and are described in a recent issue of *Engineering News*. Both natural and Portland cements were dealt with; several brands of the latter being tried. Three varieties of brick were used—viz., a hard red brick, having a specific gravity of 2·136, and absorbing 4·56 per cent. of water; a soft red brick, having a specific gravity of 1·981, and absorbing 8·81 per cent. of water; and a fire-brick, having a specific gravity of 2·000, and absorbing 5·17 per cent. of water. The cemented surfaces of the bricks were $2\frac{1}{4}$ inches square; and the joints were about $\frac{1}{4}$ inch thick. The results did not show any definite relation between the adhesive and cohesive properties of the cements; but the general conclusion arrived at was that with Portland cement the adhesive power was at least one-fifth of the cohesive, when new, and that in time it would become fully equal to it.

* See JOURNAL, Vol. LVIII., p. 205.

TECHNICAL RECORD.

THE LIMITING EXPLOSIVE MIXTURES OF VARIOUS COMBUSTIBLE GASES WITH AIR.

At the recent Meeting of the Federated Institution of Mining Engineers, a paper on the above subject was read by Dr. Frank Clowes, Professor of Chemistry in the University College, Nottingham. Our readers are aware that the author's name is connected with a process of accurately testing for small quantities of inflammable gas in air; and this fact led to inquiries being addressed to him as to the proportion of such a gas which will cause explosion when fired. He therefore undertook a series of experiments with the object of determining the least and the greatest proportion of the gas which, when mixed with air, is explosive at ordinary atmospheric pressure. These he terms the "limiting explosive mixtures." Dr. Clowes found that the mixtures were more readily kindled upward by a flame placed below them, than downward by one placed above. Accordingly, the composition of the mixtures varied with the mode of firing. The experiments were carried out with several different combustible gases and with coal gas; the mixtures varying in composition with the different gases employed. In order to accurately measure small volumes of inflammable gas in making the mixtures, the gas was diluted with nine times its volume of air. In this way, a tenfold volume could be dealt with. Allowance was made for the air thus introduced with the gas in calculating the composition of the mixture to be experimented with. The results obtained by repeated experiments made with the same gas were concordant. In every case the next percentage of gas, below or above as the case might be, failed to fire-back. Using methane, and kindling upwards, the lower explosive limit was reached with 5 per cent. of the gas mixed with air; the upper limit, with 13 per cent. Kindling downwards, the limits were 6 and 11 per cent. In the case of coal gas, with upward kindling the limits were 5 and 28 per cent.; and with downward kindling, 9 and 22 per cent. Firing water gas upward, the lower explosive limit was attained with 9 per cent. of gas mixed with air; the upper limit, with 55 per cent. Using the upward method of kindling, the following were the percentages: Hydrogen, lower limit, 5; upper limit, 72. Carbonic oxide, lower, 13; upper, 75. Ethylene, lower, 4; upper, 22. Dr. Clowes draws the following conclusions from the above results:—

(1) When mixed with atmospheric air at ordinary atmospheric pressures, different combustible gases show different limiting explosive proportions.

(2) The range between the lower and upper explosive mixtures is least in the case of methane, or fire-damp. The range is widest in the case of hydrogen; but carbonic oxide shows an almost equally wide range. The limits in the case of water gas are widely separate; but with coal gas the range of explosibility is less.

(3) The tendency to explode is greater when the mixture is fired from below than when it is fired from above. Hence the lower limit mixture contains less gas, and the upper limit mixture contains more gas, when the mixture is fired below than when it is fired above.

(4) Since the risk of explosion occurring, when a gas is mixed in unknown proportion with air, is diminished as the limits of explosibility approach one another, the gases which were employed in these experiments may be placed in the following order of increasing danger: Marsh gas, ethylene, coal gas, water gas, carbonic oxide, hydrogen.

(5) In every case the danger of explosion resulting from a naked flame being brought into contact with a mixture of unknown composition is greatest when the flame is applied to the bottom of the mixture than when it is applied to the top.

(6) It is interesting to note that Mr. Lewis T. Wright, when firing a mixture of coal gas with air in a horizontal tube, obtained, as limiting explosive proportions of gas, 10·3 and 23 per cent. respectively. The lower and upper limits of horizontal explosion here correspond with those obtained by the author for vertical downward explosion. They differ considerably from the limits for upward explosion. Hence it appears that horizontal kindling corresponds in its general character with downward kindling. It is not to be classed with upward kindling.

HYDRAULIC LIFTS ON THE WATER-SUPPLY SYSTEM OF COLOGNE.

We have received from Herr FROITZHEIM, the Cologne Engineer, a reprint from the *Journal für Gasbeleuchtung* of a paper on the above subject read by him before the Association of Rhenish and Westphalian Gas, Electrical, and Water Engineers. The following is an abstract translation of the paper:—

Many complaints have in past years reached the officials of the Cologne Water-Works of fractures and bulging in the water-mains from the violent shocks due to hydraulic lifts being directly served from the mains. There are at present 120 lifts in operation in Cologne. They may work either directly or indirectly. In the one case, the travelling platform is directly attached to the main piston, and the cylinder is placed beneath

the lowest position of the platform, and has a depth equal to the height of hoist of the lift; in the other case, the power is transmitted from the piston to the traveller by means of a chain or wire rope. The elongated piston-rod has the form of a rack, which actuates a pinion attached to a winding drum, to which depends on the one side, by a wire rope, the travelling carriage, and on the other side the counterpoise. The cylinder has in this case a diminished length, and consequently increased diameter; and it may be in any position adjacent to, or far from, the lift. Notwithstanding the diminution of safety introduced with the interposition of ropes and wheels, the indirect method of working is, from its greater convenience and cheapness, almost exclusively used in Cologne. The starting and stopping of the piston are accomplished by valves; and if the water is cut off too suddenly, the pressure in the mains may, by the recoil, be raised from the normal 3½ to 25 or 30 atmospheres.

The ordinary appliances for preventing recoil are very inefficient. Of 88 lifts, only 5 were found to work without an appreciable back-shock. It was therefore necessary to make special regulations for the connection of lifts to the town mains. In order to collect data for their compilation, a number of questions were addressed to the managers of the water-works of 25 large German towns; and in nearly every case, detailed replies were received. Twelve towns permitted the direct connection of lifts unconditionally, while six towns did so with the reservation that the permission to use the supply might at any time be revoked. Hanover required the interposition in the service of an air chamber of at least a cubic metre capacity. Berlin did not sanction the direct connection of lifts, but required a separate reservoir or an accumulator to be employed. The first is the appliance generally used there; a reservoir at a considerable height being filled from the town mains, and communicating with the working cylinder of the lift. The supply to the cistern is cut off by a carefully constructed ball-cock. In large installations, the discharged water flows into a cistern, and is pumped up to the high-level reservoir for use again. This system is also customary in Leipsic; and it is adopted in four cases in Halle. In Bremen, a reservoir must be used if direct connection is found to damage the mains or affect the supply to other consumers. There is one instance of its use in Cologne. The accumulator system employed in Berlin is that patented by Herr C. Hoppe.

No towns require any special construction of the lift or valves. A few stipulate for the insertion of an air chamber; but there is no uniformity in the dimensions laid down for it at various places. Regular examination of lifts by the water company is carried out in seven towns; and in Dresden the erection of a lift has to be sanctioned by the water supply officials, who decide for each case under what special conditions permission may be granted, if it be granted at all. The following conditions are always insisted upon: The cocks or valves that shut off the supply must not cause an impact of more than 2 atmospheres on being shut; an air chamber of sufficient capacity must be inserted in the service, and precautions taken to maintain the quantity of air within it; and a pressure-gauge must be placed on the service anterior to the air chamber.

The use of slowly-closing valves is not required by any of the towns, but must be considered as a means of avoiding shock to the mains. Two methods of attaining a gradual cutting off of the supply are available. In the first, the exit is contracted rapidly at the commencement, but the complete closing proceeds slowly; in the second, an apparatus is placed in the valve, which renders the closing of it with a jerk impossible, whether the attendant is careful or not. The appliances of the first class are of three varieties; the commonest being a three or four way cock, the plug of which has obliquely-cut slits in place of the usual orifices. Another kind resembles the slide-valve of steam-engines; the brass slide being pressed against the valve-face by a spring. The opening in the valve-face is rhomboidal, so that the passage is only slowly closed. The third kind consists of a double-headed piston; the inlet-pipe entering the cylinder between the two heads, and therefore equalizing the pressure on the piston. The exit is by a perforated brass chest, of which the orifices are cut off gradually by the piston, and the flow is consequently slowly stopped. The second means of guarding against a too sudden cutting off of the supply is by directly connecting the controlling rope or lever to the rod of a piston, working in a cylinder filled with water, oil, or glycerine. By means of a connecting-tube, the liquid can flow from one side of the piston to the other; and the rate of flow is regulated by a cock on the tube. The use of this apparatus prevents all risk of the passage of the lift being suddenly checked by the attendant.

In order to completely do away with shock, it becomes necesary to use an elastic cushion of air furnished by an air chamber. On cutting off the supply to the lift, the water in motion in the pipes flows into the air chamber, and compresses the air therein. The work expended in compressing the air is equal to the *vis viva* of the mass of water in motion. If, therefore, it is required that the pressure in the air chamber must not exceed a certain value, its capacity must be sufficiently great. In Cologne, it is required that, for every square inch section of the supply-pipe, an air space of 3·42 cubic feet must be provided in the chamber.

The regulations of the Cologne authorities recently issued will, in the end, aid the manufacturers of lifts, &c., by providing for a certain amount of uniformity in construction and fitting, though at present they appear rather stringent. They press most hardly on those who already owned lifts; but, to their credit be it said, no complaint was received from any owner. The advance made by the issue of these regulations is clear from the fact that, prior to their enforcement, of 88 lifts at work, only 5 never threw a greater pressure than 6 atmospheres, while 23 threw pressures of more than 20 atmospheres; but since the regulations have been in operation, of 108 lifts in use, 74 did not throw a greater pressure than 6 atmospheres, while in only one instance was 20 atmospheres exceeded.

The insertion of an air chamber is liable to cause over-registration by the meter of the water consumed, owing to varying pressure in the mains allowing water at times to return from the chamber. No Cologne consumer has, however, yet lodged a complaint of over-registration due to the chamber. The regulations of Cologne require anyone purposing to put up a lift to make application to the authorities for permission to erect it, and enforce certain dimensions of services and air chamber according to the size of the installation. There must in no case be a greater back-pressure than 6 atmospheres. An air chamber, and an apparatus for preventing sudden checking of the flow of water must be provided; and a fee of 6s. per annum is charged for the inspection of each lift, and the maintenance of a registering pressure-gauge on the service-pipe. These regulations have been in force since February, 1894.

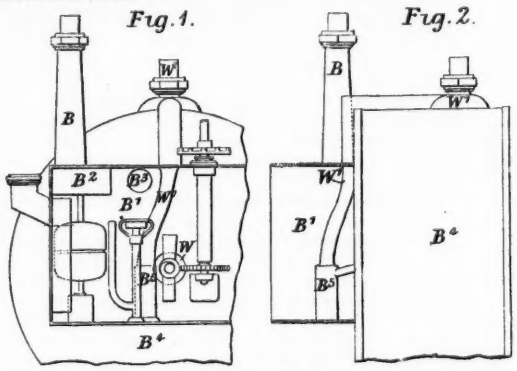
REGISTER OF PATENTS.

Burner Cap for Incandescent Gas-Burners.—Gareis, A., of Berlin. No. 7778; April 18, 1894.

This "improved cap for incandescent gas-burners" has its upper part formed of a conical shape; and in it are several rows of holes of various sizes (for allowing the combustible gas to pass through), bored vertically to the conical surface of the cap. A projection towards the interior of the cap has in it a recess open at the top, serving for holding a rod for supporting the mantle. Within the cap round the projection, layers of gauze or closely perforated discs are inserted, to produce an even distribution and a thorough mixture of the air and gas. The patentee claims that by this invention the gas and air are completely mixed; and owing to the holes being bored vertically to the bevelled or conical surface of the burner-cap—for instance, at an angle of 45°—the air and gas mixture passing out is conveyed in the most advantageous direction against the mantle placed above.

Prepayment Gas-Meters.—Cowan, W. and W. H. of Edinburgh. No. 9480; May 15, 1894.

This invention in prepayment gas-meters has for its object "to provide an efficient prepayment gas-meter having prepayment mechanism and stops attached; said stops being employed to the exclusion of a valve."



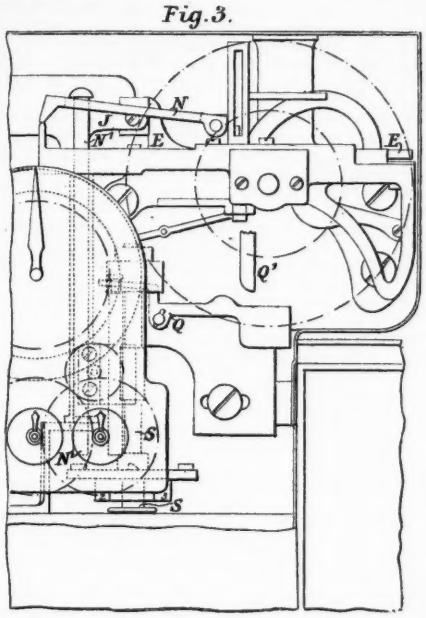
Figs. 1 and 2 are a part front elevation, and a part side elevation of a wet gas-meter, and fig. 3 a front elevation of part of an index-case of the meter having these improvements attached.

The patentees state that they prefer to employ a wet gas-meter of a similar kind to the meters described in the Pinchbeck patent of 1861, No. 979, and the Urquhart and Andrews patent of 1876, No. 104. In these the surface of water exposed to the inlet pressure is more or less considerably in excess of the water exposed to the outlet pressure; thus always ensuring an efficient seal of water at the centre opening W of the drum. For this reason, this form of meter is more applicable to wet prepayment meters in which stops are used, than other forms of wet meters hitherto employed—that is to say, the gas, after passing down the inlet-pipe B, enters the chamber B^1 through the valve B^2; thence through the opening B^3 into the drum case B^4; through the drum; and out through the pipe B^5 in the central opening W, and out by the outlet-pipe W^1. The kind of drum preferred is constructed on the Warner and Cowan principle, as described in patent No. 1698 of 1874, which enables a deeper seal to be given to the centre opening of the drum, without affecting the measurement. The prepayment mechanism and stop arrangement combined with the above form of meter is practically that described in patents No. 24,490 of 1893, and No 7988 of 1894.

According to the present invention, however, the stop which was described as the "second line of defence" is employed not as such, but as a stop to enable the prepayment or supplementary valve to be dispensed with. The pawl-shaped lever N, and depending-rod arrangement N^1, are employed for the purpose of shutting off the supply of

gas in the event of the pawl J not being returned to its normal position; and there is also employed a modification of the special stop, consisting of the pivoted lever Q, having a slotted end, and depending-rod or stop-pin, moved into gear with the cam on the upright shaft S of the meter by the prepayment or plain wheel's projecting pin. The other end of the lever Q is provided with a balance weight, as before; and its stop-pin is lifted up out of gear with the cam by the carrier's depending-rod Q^1, as already described in the earlier specifications. In this invention, the projections on the disc S do not effect the closing of a valve, but are used for the purpose of enabling stops to arrest the mechanism of the meter.

Fig. 3.



Also according to this invention, the vertical stop and pawl-shaped lever arrangement are employed for shutting off the supply of gas in the event of the prepayment pawl and wheel being left in gear—that is, when the coin-carrier has not been returned to its normal position. This may be effected as shown in fig. 3. To the front end of the eccentric carrier E is pivoted a pawl-shaped lever N, provided with a normal rest or support, formed on or attached to the carrier's track D. The lever is formed with a slot or opening, through which passes a depending-rod N^1, having an enlarged head, and provided with one or more guide-brackets. The arrangement is such that, on the eccentric carrier E being moved forward, the pawl-shaped lever N will leave its rest or support, and so lower the rod N^1 into the path of the projections on the disc of the meter's upright shaft S in a wet meter, and into the path of the ordinary tangent in a dry meter.

Further, in accordance with this invention, in some cases, if desired, the disc or cam having the projections against which the stops act is mounted on an auxiliary shaft, in lieu of on the upright shaft S, and suitably gears the shaft with the upright shaft. The ridges or projections on the disc or cam may, in some cases, be dispensed with; and a series of holes formed in the disc at or near its circumference may be employed, and into which the ends of the stop-pins and the rod N^1 would drop.

Protector for Incandescent Lamp Mantles.—Hatry, C., of Berlin. No. 12,469; June 27, 1894.

This protector is designed to prevent the fracture of an incandescent gas mantle by splinters of the glass falling against it, in the event of the chimney being fractured from any cause. The device consists of a wide-meshed wire-netting of cylindrical form open at both ends, and adapted to be loosely inserted in the lamp glass or chimney, or be suspended therein by means of hooks provided at its upper end.

Transmitting and Controlling the Power of Gas Motors.—Burt, P., of Glasgow. No. 13,546; July 13, 1894.

In carrying out this invention according to one modification, the patentee proposes to arrange the motor to drive a horizontal crank-shaft, which, in the case of a tramway car or locomotive, is disposed longitudinally thereon. There are two discs, one on each side of the crank-shaft; these discs being on the inner ends of transverse horizontal shafts at the same level as the crank-shaft. The crank is between the discs—the motor cylinder being above and inverted; while there are two fly-wheels on the crank-shaft at opposite ends beyond the discs. The discs are made with single conical frictional surfaces, for being acted on by one or other of two opposite conical pulleys, which are on sleeves or bosses on the crank-shaft, and are driven by grooves and feathers, allowing of their being moved along the shaft. A single hand-level or its equivalent is provided for acting simultaneously on both pulleys; or two or more such levers may be arranged at different parts of the car, but so that each acts similarly on both pulleys. A longitudinal shift of the pulleys in one direction puts one pulley into driving contact with the discs, for moving the car ahead; the opposite shift puts the other pulley into position, for moving backwards; while in the middle position neither pulley is in driving contact. The carrying wheels of the car are arranged to be driven by outside connecting-rods—those of two wheels on one side being jointed on a crank on one of the disc-shafts, while those of the other side are jointed on a crank-pin on a spur-wheel, gearing with a spur-wheel on the other disc-shaft.

In other modifications, the motor apparatus may be in duplicate; the two parts being arranged to act on cranks at opposite ends of the longitudinal shaft. Instead of the crank-shaft being longitudinal, it may be transverse; and the motion may be transmitted from the disc-shafts to the car-axles by bevel-wheel and worm and worm-wheel gearing.

Gas-Engines.—Crastin, C., of Holloway. No. 2550; Feb. 5, 1895.

This invention, relating chiefly to gas-engines of the "Otto" type, is more especially applicable to small engines designed to be used as domestic or laboratory motors.

As applied to a horizontal engine, the patentee forms or casts on a bed-plate an upright piece, having a circular hole, through which passes a prolongation of the cylinder; a flange being cast thereon to allow of it being bolted to the upright. At the other end of the cylinder is a corresponding flange; and the space between these flanges forms the water chamber, when covered with a piece of tube—preferably wrought-iron or steel boiler-tube, which forms the jacket. The advantage of building cylinders in this manner is that the jacket can be readily replaced by a new one in case of accident by frost; and the cylinder and jacket can be easily and cheaply made, and readily cleaned internally.

To allow of regulating the stroke of the valves—particularly of the exhaust-valve, and to provide simple means of reversing the engine, a toothed wheel is employed, wide enough to allow a cut to be made in the centre of the teeth, to divide the wheel nearly to the hole in the centre. Upon one side of the wheel, a semi-circular slot is cut; each end of it being opposite a hole in the other side of the wheel, which hole may be tapped to receive the screw-threaded end of a set-screw or pin kept in its place by a spring. According to the hole the set-screw or pin is placed in, so the engine will run in one or the other direction. When it has been passed through, a small steel roller is placed on it in the space formed by the cut in the wheel; and this roller acts upon an upright lever having an adjustable base, by means of which it is possible to vary the stroke of the rod which operates the valve. The lever acts upon a rod to open the valve; and the top or bottom end of the lever may be fitted with a cushion or spring, to prevent it striking back upon the wheel and making a noise.

For keeping the cylinder cool, the engine-bed is placed upon the top of a closed cistern; and from the top of the cylinder jacket, a short tube leads up into a small chamber above the cylinder jacket. A portion of the chamber may be formed with a glass ring, so that the quantity of water can always be seen; or it may be fitted with a glass tube, as in a water-gauge. From this chamber a pipe is led to near the bottom of the cistern, upon which the engine may stand; and from the top of the cistern, a pipe passes up through the underside of the cylinder jacket. The water will ascend into the small cistern on the top of the cylinder, and then circulate back through the other cistern, when the engine is working; or a pipe may be led into a small self-supplied cistern fixed in any suitable position, and returned to the larger cistern. For starting the engine by hand, the end or side of one of the connecting-rod brasses or head (when used with a disc in place of a crank) is formed with a projection to receive a handle; the projection and handle being so arranged as to give increased leverage to overcome the compression of the charge in the cylinder, according to the direction in which it is intended to run the engine.

To admit gas to the air-pipe leading to the cylinder, and to dispense with a gas-bag in small engines, the patentee forms the outlet of the gas cock or valve with a small opening or jet, capable of passing the maximum quantity of gas consumed by the engine at ordinary gas pressure. This jet opens into a chamber; and the outlet of the chamber is provided with a regulating-screw, so as to allow the gas to enter on the side of the air-supply pipe, and become well mixed with the air as it enters. The regulating-screw may be connected to a governor; and a light valve may be fitted to the bottom of the air-supply pipe below the regulating-screw, so as to prevent the gas escaping should the engine be stopped without turning off the gas supply.

Gas and Petroleum Motors.—Wallmann, H. F., of Chicago, U.S.A. No. 3923; Feb. 23, 1895.

This gas or petroleum motor operates in such a manner that the products of combustion, after expansion, pass through a space acting as a regenerator between the extended piston and the similarly extended cylinder to the exhaust aperture at the opposite end of the cylinder—heating the walls of the cylinder and piston; while the air required for combustion is also introduced at this end of the cylinder, travelling in a reverse direction to the products of combustion, and so as to be preliminarily heated by the walls of the cylinder and piston, for the purpose of conducting the exhaust gases and the introduced air in a reverse direction through the space between the piston and the cylinder. In this way, on the one hand, the cylinder closure is protected from the heat of the exhaust gases; and, on the other hand, the air is preliminarily heated—the length of the passage between the cylinder and piston being capable of extension by means of channels.

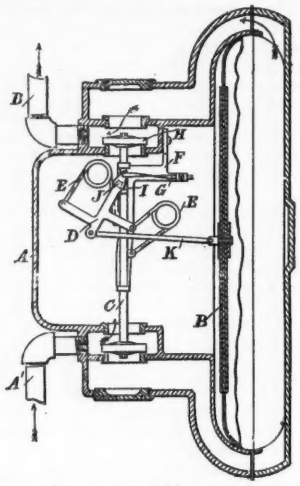
Gas-Meters.—Sprague, H. H., of Indianapolis, U.S.A. No. 5186; March 12, 1895.

This invention in dry gas-meters consists of mechanism by which "the slow even pulsation of the diaphragm is translated into a quick, positive movement of the valves, by means of a swinging frame actuated by the movement of the diaphragm, which throws the valve first in one direction and then in the other through the medium of two springs brought alternately into tension."

A [next page] is the meter-case; B, the diaphragm; C, the valve-stem; D, the swinging frame which carries the springs E; F, the bracket upon which the moving parts are supported; G, the spring upon which the frame D is hinged; H, the valve-disc; I, the lug or stop upon the valve-stem; J, the lug or stop upon the frame D; and K, the link which connects the diaphragm and the frame D. There is a lug upon the valve-stem which slides in the slot in the bracket F, and prevents the valve-stem from turning, and a screw by which the bracket is attached to the casing. A^1 represents the inlet, and B^1 the outlet.

The operation of the meter is as follows: The gas entering upon the

outer side of the diaphragm B forces it inward, and thereby carries the frame D into the position shown. This throws the valve-stem downward, closing one set of valve-ports, and opening another; and thus reversing the direction of the flow of the gas. The gas then enters on the inner side of the diaphragm, forcing it outward, and altering the position of the frame D, so that the gas flow is again reversed. The valve-stem is reciprocated by the swinging of the frame D through the medium of the springs E. One end of each spring is attached to the valve-stem, and the other to an arm of the swinging frame.



When the frame swings to one side, one of the springs is brought into tension, and the other one released; and as it swings to the other side, the second one is brought into tension, and the first released. In this manner, the valve-stem is moved first in one direction and then in the other. If there were no other controlling mechanism, the movement of the valve-stem from side to side would be slow and even. But, in order that the pulsations of the diaphragm should be even and uniform, it is necessary that the valves be retained upon their seats, and the flow continue in one direction until the diaphragm reaches a fixed point; and then instantly reversed, and retained in the new position until the opposite limit of its movement is reached. In order to accomplish this, a lug or stop I is placed upon the valve-stem, and another one J upon the swinging frame D. These lugs engage one another during the middle portion of the stroke, and slide off at each end of it. In this way, the valve is held down upon its seat while the frame is swinging from one side to the other, and one spring being released and the other brought into tension. In the position shown, the valve-stem has just been thrown downward, and the under side of the lug J comes in contact with the upper side of the lug I. As the frame moves, the lugs slide off one another; and the valves are thrown upward. Then, as the frame D swings back, the upper side of J comes in contact with the under side of I; and the valves are held upon their seats until they slide off at the other side.

The lever which operates the registering mechanism may be attached to any part of the swinging frame—preferably it is connected where the link K is attached. The valve-discs H are made of solid rubber clamped between metallic discs, and vibrate between the two valve-seats, striking first on one face, and then on the other.

Gas and Oil Motor Engines.—Southall, J., of Worcester. No. 6383; March 28, 1895.

This invention relates to gas or oil motor engines of the kind described in patent No. 18,109 of 1892, according to which the exhaust takes place when the piston has accomplished rather less than half its out-stroke—the remaining part of the outstroke (unaided by any action produced by the cooling of the exhaust gases) serving to introduce the new charge. The present improvements consist in (1) making the passage to the exhaust-valve as small as practicable, so as to reduce as far as possible the volume of its contents to undergo expansion during the charging portion of the piston stroke; (2) providing a baffle in the cylinder for the incoming charge to strike against; (3) obtaining greater expansion of the working charge, by keeping the exhaust-valve open during the instrokes of the piston until it has reached a point further in the cylinder than that point, during the outstrokes of the piston, at which the exhaust-valve is opened; and (4) providing a form of valve, &c., applicable to oil-engines generally, for the supply and vaporizing of a charge of air and oil.

APPLICATIONS FOR LETTERS PATENT

10,905.—Ridder, B. L. de, "Sampling gases for analysis." June 1.

10,931.—Imray, O., "Decomposing sulphuretted hydrogen, and obtaining ammonia, compounds of ammonia, oxysulphides, sulphides, and sulphur." A communication from Messrs. Goerlich and Wichmann. June 1.

10,947.—Riche, H., "Manufacture of gas." June 1.

10,999.—Lyst, F., "Anti-fluctuating gas chamber for controlling, drying, and enriching gas for use in gas-engines and other gas supplies." June 4.

11,015.—Dauber, A., "Continuous working recuperative gas-furnaces." June 4.

11,038.—Knöfler, O., "Incandescence mantles and the like for gas and other burners." June 4.

11,113.—Tompson, C. P., "Pipes and vessels for liquids for the prevention of bursts caused by frost." June 6.

11,119.—Henderson, J., "Charging gas-retorts and similar vessels." June 6.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by correspondents.]

Carburetted Water Gas.

Sir,—In so far as Mr. Westcott's letter in your last issue relates to Mr. Broadberry's paper, I have no intention of dealing with it; but I am able to state that Mr. Westcott's reading of the technical policy of the United Gas Improvement Company has no warrant in fact, unless such warrant be found in the circumstance that this Company has not yet displaced all of the early, or as Mr. Westcott terms it "combined," apparatus, by the Humphreys double-superheater setting, and that it still builds a "junior" setting of 2000 cubic feet hourly capacity on the original "combined" plan, for villages where first cost is the ruling consideration.

When in the service of The Gaslight and Coke Company—whose installations are now entirely on the double-superheater system—I had some experience of an experimental plant dispensing with a carburettor; and the comparative results were fatal to it.

It is significant that the only Company that has latterly erected any appreciable amount of work in the United States upon the single-superheater system is, from the patent columns of your issue for April 2, 1895, and from its American advertisements, now adopting the double-superheater type for all important work. It is consistent in this connection that the plant now being erected in New York is an extension of present double-superheater settings, but of the Humphreys-Glasgow European type.

With regard to fuel figures, the material used in America being for the most part anthracite or oven coke, it seems needless to emphasize the fact of its being used *cold*. I am at a loss to understand how hot anthracite is to be used in a generator. Moreover, the carbon-energy of these fuels is far higher than that of the average gas coke in this country; and as the former are, of all fuels, the best adapted to the purpose in question, I consider any comparison of respective results nugatory and misleading.

I have by me one American figure of fuel economy on the double-superheater system. The installation of the new East River Gas Company (supplying gas from Long Island to New York through the much-talked-of river subway) was started at the beginning of this year; and when running only ten hours daily, consumed 28 lbs. of anthracite per 1000 cubic feet in its generators.

It would appear that, to revert to the early form of apparatus known as the single superheater type, would be held as retrogressive in advanced American practice; and this view is confirmed by an interesting *résumé* of water-gas processes in *Progressive Age* (New York) for March 15, 1894.

I have had my attention drawn to results quoted from the Toronto works in support of the single-superheater system. Unless the information by me is incorrect, by far the larger part of this water-gas plant is upon the double-superheater system; and I do not consequently see the bearing of the citation. Certainly, there is nothing in the results beyond what is ordinarily expected from double-superheater settings.

It should not be lost sight of that, as a point of financial economy, the oil-results are very much more important than the fuel—especially so in this country; and it was the successful treatment of oil which called for the design of the double-superheater system, and which has since secured its almost universal adoption.

A. M. Paddon.

9, *Victoria Street, S.W., June* 15, 1895.

The Proposed New Standard of Light.

Sir,—I was pleased to read the criticism from Birmingham, in the Journal for the 4th inst., upon the very important subject of the proposed new standard of light; and I wish to say that the Board of Trade has lent itself to a work so very local in its special application as to call for a strong protest from the North. Their Committee ought undoubtedly to have been a national one; for though London may, to a Londoner, be the "hub of the universe," the country, from north to south, is not without a due sense of its own needs and importance. A foot-rule and a pint-measure are established for use in and out of London; and in gas valuation the same simple principle should be adopted. In the North, the gas is usually tested by a flat-flame burner; and as this burner is cheap and in general use by consumers, there is a fair and equitable relation in the expression of value supplied and actually obtained in consumption. Would the gas in London be better or worse for the customer's use if tested by a flat-flame burner? I think not. Then why should a burner of fanciful construction, such as the Argand, be reached after so eagerly by the London Gas Companies? There is no limit to shrewd invention when backed by self-interest. I claim that the Board of Trade should sanction only such methods of gas testing as are suitable for national application, and thus relieve the gas industry from the objectionable and odious comparisons which are so often made between one town and another, when the conditions of testing are so irregular. I do not altogether agree with Mr. Hunt in his desire to have the glass chimney filled with flame, nor with the recommendation of the Committee that the rate of consumption should be raised to show the required illumination upon the disc—a suggestion most disastrous to the poor consumer, and little in keeping with the command of "a full measure and running over" which is equitable between man and man. A flat flame and a plain open photometer may be asked for on the grounds of fairness combined with simplicity; and these an impartial and national tribunal would be more disposed to grant than a Committee who, by their results, seem to me to have taken the narrow view of the requirements of the London Gas Companies alone.

Though much praise has been given to the South Metropolitan Gas Company for providing the expenses of the Committee, it occurs to me that the country generally would think itself better served if the cost had been met in a different manner. As the action of the Board of Trade concerning London gas affects the provinces in a very strong

manner, I hope Parliament will not adopt the present report, but that the way will be left open for a national system of gas testing to be adopted.

Manchester, June 10, 1895. E. WILLIAMS, F.C.S.

Sloping Retorts at Brentford.

SIR,—If Mr. Brackenbury will consider my previous reply, he will see that he has been answered, as it was at the Brentford Gas-Works that the "sloper" system of charging retorts was first thought out, tried, tested, and perfected. Thence, as agreed, the drawings must have come; and so they did. I know that they could have come from nowhere else. Further, as Mr. Husband has continuously worked the system, for and under Mr. Frank Morris, since the first trials, he has, from time to time, improved or added details, and has freely communicated them to all who desired to know; and in his paper he offers still to do so. If Mr. Brackenbury wishes to learn how to *thoroughly* burn off his coal, dry and clean, with no tar in the mouthpiece, and still sell more than 12 cwt. of weighed coke per 20 cwt. ton of coal (no estimating the makes, which is a simple way of balancing the fuel account), he might spare the two hours that his letter would take to compose, and examine the setting and method of working at Brentford. It is worth knowing; and it would pay him as a study. He would then be in a better position to write usefully.

As for the rest of Mr. Brackenbury's letter, as to how an Englishman (let me add a "Cockney") has a strange name, and other matters, a reply would not benefit your general readers, and would merely advertise your two correspondents gratis.

June 15, 1895. L. VAN VESTRAUT.

SIR,—In reply to Mr. Travers's letter, I know Field's "Analysis" shows less make per ton. The tests we made with eight horizontal sets against eight sloping sets, with coal from the same ship, and both houses worked on the regenerator principle, always showed an average of 100 cubic feet more in favour of the "slopers"—the illuminating power being the same. The carbonizing wages now include all stage work—that is, charging, drawing, and throwing back coke, firing, stage foremen, exhauster-engine drivers, and boiler men. Mr. Morris has taken out yard work, which includes a variety of charges not having anything to do with carbonizing; so, as I have said before, this year will be a fairer test of sloping retorts, as I should think 85 per cent. of the total make will be by these retorts. Delivery of coal into hoppers has never been charged to carbonizing; and therefore the fact of coal being placed in the hoppers more cheaply would not in any way affect the cost of carbonizing. Of the total make in 1893, about 60 per cent., and in 1894 about 65 per cent., was produced in sloping retorts.

Brentford, June 13, 1895. J. HUSBAND.

Mr. Marshall and the Monier Arch.

SIR,—The interest attaching to the above subject prompts me to offer some remarks thereon, as suggested by your leading article on the 11th inst.

The determination of the fact whether the form of arch in question is in tension or compression, or both, in different portions, is of interest to engineers generally; and its demonstration should, I think, be considered not solely upon the grounds of mathematical formulæ *per se*, but upon experimental data on the actual behaviour of shallow arches (allied to beams) under heavy or breaking loads, as agreeing with accepted formulæ on the subject. Here is an opportunity for the experts in strains in structures who have dealt ably with complicated problems affecting gas engineering structures. Gas engineers, it is certain, will be more interested in the practical fact made evident by Mr. Marshall of the cheapness and strength of the Monier system. The application of ironwork in concrete is here no longer an experimental method of construction, but a system worked out to its best advantage; and the fact of its having been done by Continental engineers should not prove a bar to its adoption in this country. In English gas-works, hoop iron laid in tank and retort-house walls, and that subject to varying opinions, has hitherto represented the extent of its adoption.

The writer has for some time considered an extension of this system of construction by the application of light steelwork in the walls of brick or concrete buildings. This is with a view of increasing their strength as whole structures braced and tied together, lessening the weight on the foundations, and giving a more effective resistance to the distorting strains of settlement than buildings erected only in *mere mass*, and relying *solely* on their *bulk* and *weight* for stability. It is refreshing to meet a principle of gas-works construction which is the antithesis of the practice of "lumping in" an excessive bulk of material, often in inoperative positions, or merely for the sake of appearances. Just the needed quantity and quality of material in the right place to do its work, combines true engineering and the investment of capital on correct commercial principles.

Concerning the form of coal-stores and strains on the side walls owing to their contents, it appears to me to be due to the fact of the coal resting in a heap at, or nearly at, its angle of repose when the store is full. The angle carries the upper portion of the heap independently in itself, without exerting any horizontal thrust; while the total "dead weight" of the coal is supported by the Monier arches below, in a similar way to the storage of grain on granary floors in conical heaps without thrust on the side walls.

In conclusion, I consider the thanks of gas engineers are due to Mr. Marshall for the high example set by the open-minded manner in which the paper and its details are given to the profession, and by his liberal offers of additional details and information to those interested.

June 13, 1895. J. CHAMBERLAIN.

The De Mare Incandescent Gas-Light System, Limited.—Temporary offices have been taken by this Company at 111, Palace Chambers, Westminster, S.W.; and Mr. C. J. Roberts has been appointed Secretary.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS COMMITTEE.

(*Before the Earl of* JERSEY, *Chairman; Earl* GREY, *Lord* MENDIP, *Lord* CALTHORPE, *and Lord* CRAWSHAW.)

CHESTERFIELD GAS AND WATER BOARD BILL.

This Bill, the object of which is to empower the Corporation of Chesterfield to purchase the undertaking of the Chesterfield Water and Gas Company, to form a Gas and Water Board, to supply gas and water to Chesterfield and the district, and for other purposes, was recently considered by the above Committee.

Mr. LITTLER, Q.C., Mr. J. D. FITZGERALD, and Mr. MACASSEY appeared for the promoters; Mr. BIDDER, Q.C., Mr. PEMBROKE STEPHENS, Q.C., and Mr. RAM, for the Company.

Mr. LITTLER, in opening the case, said the Chesterfield Water and Gas Company was established as far back as 1825; but there had been no complaint with regard to their gas up to last year. There had, however, been serious complaints as to the quality and quantity of the water, and to the Company's charges, and especially to their refusing to supply water to houses under £10 rental, as 90 per cent. of the houses in the Chesterfield district were of this class. For a very long time, the Company avoided coming to Parliament; and at length their supply became insufficient. Last year they sought to spend £100,000 in order to get a further quantity of water and to largely increase their charges. The Corporation of Chesterfield opposed the Bill, on the ground that the Company had behaved so badly that the Corporation meant to ask Parliament to allow them to take up the supply of water themselves. The result was that the Committee decided that the preamble of the Bill was not proved, and expressed the opinion that the Corporation should purchase the whole undertaking on fair and reasonable terms. Notwithstanding that the Committee went a little beyond what the Corporation contemplated, they felt it their duty to propose to purchase both the gas and the water undertaking, although they would have preferred to purchase only the water. However, they had come with a Bill which they thought thoroughly carried out the direction they had from Parliament last year. Inasmuch as the outside authorities, some of whom were supplied with water, desired to be represented, and to join the Corporation in the purchase and control of the undertaking, a Water Board would be established by the Bill. It would be a Board of twelve members, to be called the Chesterfield Gas and Water Board. Of these members, eight would represent the Chesterfield Corporation; two, Whittington; and two, Newbold and Dunston. Clause 20 of the Bill provided that the Company should sell their undertaking to the Corporation for such sum as might be agreed upon between them, or upon such terms as might be determined by arbitration under the provisions of the Public Health Act, 1875. He understood the Company did not so much object to this, provided that, if the arbitrators differed, an umpire should be appointed.

Mr. PEMBROKE STEPHENS remarked that the Company did object.

Mr. LITTLER said the Bill also provided for the transfer of the undertaking to the Corporation, who took over the Company's powers. There were subsidiary arrangements as to outgoings, pending actions and contracts, and the making of the mortgage debt a continuing charge on the undertaking. The Company were the only opponents of the Bill; and he did not think there was anything else in the measure which affected the Company. This was the whole question; and the district was absolutely unanimous in applying to Parliament to carry out the pledge given by the Corporation last year.

Mr. PEMBROKE STEPHENS said he did not intend to enter into the question as to whether the Company had been well or badly treated. They were bound by Parliament. All he said was that the Bill as it stood was not a redemption of the Corporation's pledge.

Mr. LITTLER contended that the Corporation were doing more than they pledged themselves to do, because they were also purchasing the gas undertaking.

Mr. PEMBROKE STEPHENS said there was one point in the petition which distinctly affected the preamble. Last year the Corporation bound themselves to the decision of the Parliamentary Committee, which, if it meant anything, meant that a Bill should be introduced by the Corporation to buy at their own expense the undertaking of the Company. The present Bill was not a Bill by Chesterfield at all.

Mr. LITTLER said that point was not raised in the petition.

Mr. PEMBROKE STEPHENS said this was not the Bill in the contemplation of the Committee last year; but he had a much more substantial point than that. Who was going to buy the undertaking of the Company, and how were they going to pay for it? Chesterfield was not going to buy; nor were the other Local Authorities going to do so. But a Board was going to buy; and that Board had not rates to the value of 6d. with which to purchase the undertaking. In other words, the Company were asked to hand over their undertaking, upon which the Board would borrow money and pay them. There was no obligation on the purchasers to put their money down before they had the undertaking in their possession.

Mr. LITTLER contended that this point was not raised in the petition; but he pointed out that, by clause 33 in the Bill, the Board would have no power to take the Company's property until they paid for it; and by clause 44, they would be able to pay for it out of the rates.

Mr. PEMBROKE STEPHENS submitted that there was no power to borrow on the rates, but only on the gas and water undertaking when it was transferred.

Mr. LITTLER said the Bill created a Water Authority, which would have a right to levy rates; and therefore they had money.

Mr. PEMBROKE STEPHENS said, if it was made clear in the Bill that the Company should have the ordinary security of rates, his objection on this point would be at an end. But he was not warranted in allowing the undertaking to go without it being clear beyond all doubt.

Mr. LITTLER said that in clause 33 it was as clear as possible. He was not going to raise the powers in the Bill, especially as the point had not been brought forward until that morning.

Mr. PEMBROKE STEPHENS said so long as that was not done, he must oppose the preamble.

Mr. *J. Middleton*, the Town Clerk of Chesterfield, was then called, and gave evidence in support of the Bill. He said that until that morning he had not heard any suggestion such as had just been thrown out. As a matter of fact, there was no doubt or difficulty whatever that, as soon as the arbitration was over, the Corporation would be in the possession of funds to pay.

In answer to Mr. PEMBROKE STEPHENS, witness said directly the Bill passed they would have power to borrow money under the Public Health Act, 1875.

Mr. LITTLER pointed out that, if the Board had not the money, the Company were not bound to sell, because, if the Board could not pay, they could not touch the Company's property. If a time-limit were fixed, and the Board could not purchase, the matter would come to an end.

Mr. PEMBROKE STEPHENS remarked that this was not the undertaking of last year.

In further cross-examination, witness said he did not think it necessary to put into the Bill a provision that the Company's undertaking was to be paid for out of the rates. He thought the measure was perfectly adequate for its purpose.

Mr. LITTLER intimated that this was the case for the Bill.

At this point, Mr. Bidder, Mr. Pembroke Stephens, and their clients, had a long consultation. At its conclusion,

Mr. BIDDER said he was hoping that he would have been able to save the time of the Committee. This, however, was not so. He then proceeded to open the case for the Company. He contended that the Bill of last year was rejected by the Parliamentary Committee because they relied on the pledge of the Corporation not only to introduce a Bill to purchase the Company's undertaking, but also to construct the new works necessary for the water supply of the district. Where was the fulfilment of that pledge in this Bill? There was no proposal to execute works. It was simply a Bill to acquire the undertaking of the Company. Neither did the Bill carry out the wish of the Committee, that the Company should be treated fairly and reasonably. Then, supposing the Bill was passed, there was no power in it to enable the promoters to carry it out. They could not buy the Company's undertaking unless they had the means of getting the money first. He further contended that the arbitration as to the terms of purchase should take place under the Lands Clauses Act, because it was a case of compulsory purchase. He also suggested that the Corporation ought to pay the winding-up costs of the Company.

Mr. LITTLER agreed to that.

Mr. BIDDER also claimed compensation for the Company's officers.

Mr. LITTLER said, if the Committee thought it right, the Corporation would pay compensation to officers of the Company who had been in the service for seven years, and who were not taken over by the Corporation.

The Committee decided that the preamble of the Bill was proved.

On the suggestion of Mr. BIDDER, a clause was agreed to by Mr. Littler which provided that, if the Corporation did not exercise their power to purchase the Company's undertaking within twelve months, the power should lapse.

Mr. BIDDER next proposed the insertion of a clause providing that arbitration as to the terms of purchase should be held under the Lands Clauses Act, "provided that, for the purpose of any such arbitration, the sale and purchase shall be deemed to be a sale and purchase by compulsion, and not by agreement;" that compensation should be given to officers and servants who had been in the regular employment of the Company for five years, in respect of any loss of office or diminution of income or salary; and that the Company's winding-up costs should be paid by the Corporation.

Mr. LITTLER contended that the Arbitrator should be left with a free hand.

The Committee decided that the arbitration should be under the Lands Clauses Act, but refused to accept the words suggested by Mr. Bidder as to compulsory purchase. The other points in the proposed clause were agreed to—a provision being inserted that the Directors should not be compensated, and that, in case of dispute as to the amount of compensation, the matter should be settled by arbitration.

The proceedings were then adjourned until the following day, in order to allow the officials of the Company to bring up a clause dealing with the distribution of their assets.

HOUSE OF COMMONS COMMITTEE ON LONDON WATER BILLS.

(*Before the Right Hon.* D. PLUNKET, *Chairman; Sir* J. KITSON, *Sir* H. STAFFORD NORTHCOTE, *Mr.* BALDWIN, *Mr.* BURNIE, *Mr.* MUNTZ, *Mr.* P. STANHOPE, *Mr.* AINSWORTH, *and Mr.* BRIGGS PRIESTLEY.)

Twelfth Day—Wednesday, June 12.

To-day the proceedings of the Committee were resumed after the Whitsuntide recess.

Mr. *Cripps* was recalled for the purpose of making some verbal corrections in his evidence, when

Mr. LITTLER directed his attention to the necessity of making a more serious correction in relation to the alleged breach of faith with Parliament in the Companies not carrying out their pledges not to charge the maximum rates. Mr. Cripps had carefully refrained from saying what Parliament did upon that occasion; but the fact was that Parliament did not accept the Companies' proposals. He asked that he might be allowed to cross-examine Mr. Cripps as to whether, at the time he gave evidence, he was aware of the action of the Committee on the Companies' proposals; but inasmuch as there could be no doubt about the fact, he should have thought the easier course would be to read that part of the proceedings.

The CHAIRMAN said, as a question of practice, he thought it was rather a matter for Mr. Littler to submit at some later stage of the proceedings.

Mr. LITTLER said that all he asked was to be allowed to supplement his cross-examination, for the reason that, when he cross-examined Mr. Cripps a few days previously, he was in ignorance of certain matters upon which he now wished to cross-examine him.

The CHAIRMAN assented to this course, and

Mr. LITTLER then asked the witness whether he was aware that the Committee, subsequent to the pledges of Serjeant Wrangham, reduced the Companies' maxima in respect to various matters.

Witness said there was no doubt there was a reduction from what was originally proposed in the Bill.

Mr. LITTLER: It is very important that the Committee should have known that—at least, we think so. When you talk about pledges given in Serjeant Wrangham's speech, I say with emphasis that the pledges were given on the Chelsea Bill as it stood. The Committee damaged the Bill so seriously, that the Company had to consider whether they would take it at all. On the following day, the Counsel informed the Committee that it was a question whether the reduction of the water-rental was not such as would endanger, interfere with, and jeopardize the carrying out of the works. Mr. Simpson, the Engineer to the Company, was put into the box, and expressed the opinion that, though he could carry out the works, the action of the Committee would leave them no margin; and they must look for further income by the extended works of the Company after the new supply had been brought in. Where was there a pledge not to charge the maximum granted by the Committee; and where was the broken pledge of the Company?

Witness replied that the whole principle on which the Companies asked for that scale of charges was discussed over and over again before the Committee; and there never was any abandonment whatever of what he called the distinct pledges given by the Companies.

Mr. LITTLER said that all those pledges were given to induce the Committee to pass the Bill as it stood; and he asked if the Bill was passed in the form in which it was when Serjeant Wrangham gave those pledges.

Witness replied that it was not; but Mr. Simpson did not withdraw the understanding, or modify it in any way.

Mr. LITTLER: Can you tell me, after Mr. Simpson had stated that there would be no margin, if there is a single syllable on the part of any Company stating that they were not going to charge up to the full maximum.

Witness: I cannot, because that was the conclusion of the case, and nothing occurred subsequently. Witness went on to explain that the pledge was given in the opening stages and in the evidence; and the Committee acted upon it by passing the clause which the Company asked for, giving them the privilege of charging not exceeding certain rates. What Mr. Simpson pointed to as the source of future income was the extended works of the Company after the new supply should have been brought in. There was not a single word to suggest that he was going to charge the maximum rates.

I ask you, from that date forward, is there one single word which shows that any pledge was given on the part of the Chelsea Company, or any other Company, not to charge up to their maximum?—Of course there was not, because that was the end of the case. After the end of the case, there was no necessity for it.

Did not you consider all this material to be laid before this Committee?—I think the whole of those proceedings are exceedingly material; but I endeavoured to give the shortest possible summary to the Committee of the main points.

But this is the main point of all, when you state that the Companies pledged themselves not to charge up to their maximum. Parliament altered the maximum; and I ask you, after that, is there a single word pledging them to that?—No; I have already said the case was over.

Mr. PEMBER said he had the materials for asking the same questions on behalf of the Company he represented; but as the point had been raised by Mr. Littler, he would not pursue the matter.

Mr. POPE said that, as representing two of the Companies, he would simply say that their object in raising the question now was not to argue whether they were right or wrong in their construction of the proceedings before that Committee, but simply because it had gone forth to the public that the Companies had broken their pledges to Parliament; and he desired that the public might know that the Companies denied emphatically that they had either made or broken any pledges.

The CHAIRMAN then directed the attention of Counsel for the promoters to the point which the Committee desired to have argued. Up to the present, there had been nothing to convince the Committee that the Arbitrator, should he be so disposed, would be prevented from going into any of the matters contained in clause 6; and therefore it was a question whether it would not be better and safer to leave the clause at the words "have regard to all the circumstances of the case." It would make an enormous difference in conducting the case.

Mr. BALFOUR BROWNE said he hoped to be able to convince the Committee that the Arbitrator, even if disposed to take into consideration all the matters mentioned in the clause, could not do so under those words; and that, if he did, his award would be set aside as being beyond his power. He would not have discretion with regard to most of them; and he ought not to have discretion as to whether he should consider them. The County Council did not wish to direct him how to find; but they wanted those matters to be before the Arbitrator. The Arbitrator would not be able, without direction, to consider the question of the necessity of going for new sources of supply, or to deal with the legality of the Companies' charges, or the powers of competition between the Companies; and he was not quite certain that he would be able to consider the condition and state of repair of the various apparatus. Nor would the Arbitrator, unless he received an absolute instruction, have the discretion of saying whether the Companies' income should be lower; but he would say: "Your income is so and so; and Parliament has not made you lay your pipes at such a depth as to avoid frost."

The CHAIRMAN said, supposing the question of a new source of supply by going to Wales or elsewhere were raised before the Arbitrator, he would be asked to found his judgment upon the case of the present supply not being satisfactory. If evidence was given in that respect, he could understand perfectly well his forming some judgment upon it. What was the difficulty of the Arbitrator considering that, if there was placed before him a case of a very bad supply at the present moment? Could not he form some judgment upon that point.

Mr. BALFOUR BROWNE said that he thought, without a special instruction, merely under the general words of the clause, no Arbitrator would consider it. If he did do so, he would be able no doubt to appraise the value of it.

The CHAIRMAN: Here is an Arbitrator who, upon your thesis, is able to appraise it. Counsel says: I require you to appraise some value in diminution of what otherwise would be the price of this Water Company, because of that matter. Now you tell me the Arbitrator will not say "I will not go into it because it is impossible to estimate it," but for some other reason.

Mr. BALFOUR BROWNE: Yes; because, under "all the circumstances of the case," he would simply look at the legal circumstances and position of the Companies, and not to the action of Parliament in future.

The CHAIRMAN: But supposing the Arbitrator were to take that course, and Counsel for the London County Council insisted still upon his taking it into consideration as one of the circumstances of the case, would it not be possible for the Council's representatives to call upon him to state a case in some form to bring under the judgment of a Court of Law whether the Arbitrator was justified in rejecting this particular evidence.

Mr. BALFOUR BROWNE said it would be perfectly competent to ask that; and possibly the Arbitrator would feel bound on such an important matter to state a case. But he thought the decision of the Court would be confined to the meaning of "all the circumstances of the case;" and he did not expect that would be held to include all the things mentioned in clause 6—in fact, those words had already been the subject of discussion in the Courts of Law. He dared say the Committee would remember the case of the reredos of St. Paul's, where the Arbitrator had power to consider all the circumstances of the case. There was a suggestion that he had not done so; and the two Judges of the Court of Queen's Bench differed in their opinion on the matter. In the Court of Appeal and the House of Lords, the words were held to be nothing more than a large discretion. He desired in the present case to call before the Committee a large body of engineering and other evidence, to show that there was a probability of a future source of supply being required.

The CHAIRMAN asked why the Committee should hear it first, and then that the same kind of thing should be gone over again before the Arbitrator. Why should it not, with equal fulness, be submitted to the Arbitrator when he was determining what the price was to be.

Mr. BALFOUR BROWNE asked if the Committee would give a direction to that effect—viz., that the Arbitrator should consider anything which they might submit to a Parliamentary Committee. That was the European Arbitration Act.

Mr. MUNTZ: You want us to give an instruction that the Arbitrator is to take into consideration matters which he otherwise legally would not be able to take into consideration.

Mr. BALFOUR BROWNE: Yes, matters which he could not legally take into consideration under the general words of the clause.

The room was then cleared; and the Committee remained in private consultation for upwards of an hour, after which

The CHAIRMAN said: This is the decision that the Committee have agreed to. The Committee are of opinion that, if this Bill should become law, and if the consideration to be paid by the London County Council for the transfer of the undertakings is to be determined by arbitration, the Arbitrators should, in determining the fair and reasonable value of the undertakings, have regard to "all the circumstances of the case," as provided in lines 30 and 31, page 7, clause 6; and the Committee would be willing, on consideration of the clause, to introduce, if necessary, other general words in order to render it absolutely clear that the Arbitrators are not to be precluded by any legal objections from entertaining all the circumstances which they may think it right to take into their consideration—say, for instance, the report of the Royal Commission of 1893. It is obvious that such an important document should be open to the consideration of the Arbitrators; but the Committee merely refer to this as an illustration of what they mean. As to the subsequent provisions of clause 6, the Committee are not convinced that they are needed in order to enable the Arbitrators to take evidence upon, and have regard to, any or all of the matters therein referred to, if in their discretion they should think fit to do so. The Committee do not feel justified in endeavouring to influence in any way the impartial exercise of that discretion; or, by special reference to particular circumstances, to seem to prejudge their consideration; or by implication, to exclude or affect the consideration of any others which may be submitted to the Arbitrators. The Committee think it should be in the power of the Arbitrators, at any stage of their proceedings, to obtain the decision of a competent Court of Law on any questions which they may desire to submit for such decision; and the Committee will be ready, if necessary, to introduce words for that purpose into the Bill, in case they should declare the preamble to be proved. The Committee, of course, cannot proceed further to-day. I do not know whether it would be convenient for us to meet again to-morrow, or whether Counsel would wish for time to consider the matter.

Mr. BALFOUR BROWNE said it would be an advantage if they had a little time in which to consider the decision; and he would refrain from saying a word about it at that instant.

Mr. LITTLER said that, as far as his Company were concerned, he desired to remind the Committee that they had not yet heard the arguments against the clause, even in its modified form. He had not attempted to show cause to the Committee that it was not justified, although the Committee had indicated to a certain extent what their view of the matter was. Personally, as an advocate, he had a very strong opinion that the arbitration should be under the Lands Clauses Act, and nothing else; but as to that, he had not yet had an opportunity of laying his case before the Committee. At the same time, he had no objection to an adjournment, in order that all parties might consider what the Committee had said.

Mr. BALFOUR BROWNE said the matter was one of great importance to his clients; and as one of the Committees which they wished to consult would meet on Thursday afternoon, it would be convenient if the further proceedings were adjourned till Friday.

The Committee then adjourned till Friday.

Thirteenth Day—Friday, June 14.

On the re-assembling of the Committee to-day,

Mr. BALFOUR BROWNE said that, since the decision of the Committee on the previous Wednesday, the promoters had very carefully considered the position. They understood that it was the intention of the Committee that either side should be entitled to insist upon all matters which, in the opinion of either party, affected the value of the undertaking—as, by way of illustration, the report of the Royal Commission (using the Committee's own words)—being considered by the Arbitrator, and that he would be able to give such weight to these matters as he thought right; and they saw no difficulty in bringing up a clause in general terms (again using the words of the Committee), in lieu of clause 6, which would carry out this intention. The Chairman had suggested that the course they were taking, though it was out of the ordinary one to some extent, might shorten the proceedings. So far as the promoters were concerned, it had had that effect; as they considered the Committee accepted the proposition that they had made out a *primâ facie* case for the transfer of the undertakings to the County Council.

The CHAIRMAN: You mean subject to what may be said on the other side.

Mr. BALFOUR BROWNE said he qualified it, that it was a *primâ facie* case, only so far as the promoters were concerned, for the transfer to the County Council on terms to be agreed, or, failing agreement, to be determined by arbitration under a clause in conformity with the Committee's decision, or rather their suggestion; because, as the other side rightly said, it was, of course, not a final decision. If they were right in this construction of the Chairman's statement, that was the preamble of the Bill. Of course, they would have to hear what the opponents had to say against the preamble; but, under the circumstances, and having regard to the time at their disposal, they did not propose to offer any further evidence at that stage of the proceedings. When they came to clauses, of course it might be necessary to ask the Committee to hear further evidence; but at this stage they would not offer any, bearing upon the preamble, unless there were any points upon which the Committee desired further information.

The CHAIRMAN: You must use your own discretion as to that.

Mr. BALFOUR BROWNE said he was perfectly prepared to use his own discretion, and to close his case on the preamble; but part of his discretion permitted him to say that, if there were points on which the Committee wanted information, the promoters were ready to give it. Using his discretion, he would close his case; and it would be for the opponents to show that the preamble was not true.

The CHAIRMAN: As regards the last part of your observations, of course, as you say, it is in your discretion. You know much better than I do the issues raised between the Bill and the petitions presented against it; and if you consider that, subject to what I may have to refer to presently, you have given as much evidence as you please, that is, of course, for yourself to decide. As regards the view of the Committee, we did convey to you that, subject to what may be said on the other side, there was a *primâ facie* case, as the Bill was sent to us—without expressing our own opinions individually on the policy of the matter—for the transfer to a Central Authority; and, in the absence of any such body proposed by the petitions against the Bill, we felt that we could not go into the setting up of such an alternative authority at this stage, whatever the individual opinions of the members of the Committee might be. It will therefore be open to the opponents of the Bill to make any case upon their petitions and upon the Bill against the preamble of the Bill as being proved. But as regards the first proposition that you have submitted to us as your view of the decision we arrived at the other day, I understand you to say that you think, if the construction you put upon our decision is the right one, that you will be able to bring up, when we come to that clause, general words which will be satisfactory to you. But, of course, the particular point on which you desire information at present is what we intended by the decision at which we arrived.

Mr. BALFOUR BROWNE: That is so.

The CHAIRMAN: And what you say is this: That each side should have the right to insist upon all matters which, in the opinion of either party, affect the value of the undertaking—as, by way of illustration, the report of the Royal Commission—being considered by the Arbitrator; and that he will be able to give such weight to these matters as he thinks fit. Of course, there may be a little ambiguity about the word "considered," which I should say probably would not be easy to define, until you propose words in the clause which you refer to; but the only qualification I can make to the construction which you have put upon our words is that you must remember in a subsequent part of the decision, in addition to what you have referred to, there are these words: "As to the subsequent provisions of clause 6, the Committee are not convinced that they are needed in order to enable the Arbitrator to take evidence on, and have regard to, any or all the matters therein referred to, if in their discretion they should think fit to do so"—that is to say, to take evidence on, or give weight or have regard to. Therefore, under this decision, while it will be in the power of either side to require, in the first place, that the Arbitrator should "have regard to all the circumstances of the case," when he comes to decide what he considers to be "the circumstances of the case," it will be the right of either party to submit to him whatever matters they may think fit, and in that sense to consider them; but when those considerations have been submitted to him, it will be for him to decide whether he is to take evidence upon, and have regard to, any or all the matters, if in his discretion he should think fit to do so.

Mr. BALFOUR BROWNE: Of course, I have no right to cross-examine the Committee; but it is important——

The CHAIRMAN: I think that is as far as I can go at present. You must take the decision as we have given it. It was the result of very careful consideration in endeavouring to do what was fair and right between the two parties.

Mr. BALFOUR BROWNE said that what the promoters thought was that the Arbitrator should be asked by Parliament to hear everything that either party thought essential; but that, of course, he should not be bound to act upon either party's suggestion.

The CHAIRMAN: The words of the decision I have given are, I think, amply clear. I only go so far as to say that we did consider it was the

right of the Arbitrator to listen to what might be put forward to him as matters which ought or ought not to be gone into; but that, the parties on either side having stated their views, it would be for the Arbitrator to say how far he would go into evidence, and how far, if at all, he would give effect to the contentions on either side. But you see we guard against in the slightest degree prejudging what the decision of the Arbitrator will be.

Mr. BALFOUR BROWNE thought, with the assistance the Chairman had given them, they would now be able to bring up a clause.

Mr. POPE, as representing some of the Water Companies, said that his friend must use his own discretion as to whether he closed the case in support of the preamble; but he respectfully protested that the Committee ought not to throw out any hint as to where his proof on the preamble was short, in order that he might supply it to their satisfaction. In that view, the decision of the promoters, although it might be desirable as a matter of tactics or advocacy, had come to some of the opponents as a surprise. Having looked at the suggestion—he would not call it a decision—of the Committee, he took it to be this: That it was an intimation to the promoters that, come what might of the general principles of the Bill, the Committee would not assent to giving them the power to purchase upon any better terms than those which were indicated in the Memorandum which the Committee submitted to them—in other words, that the special instructions to be given to the Arbitrator should be struck out, and that it should be left to general expressions to be addressed to the discretion of the Arbitrator. That, of course, left the whole question of the preamble open to the opponents of the Bill. It left also the whole question of any suggestion which the opponents might have to make, directed even to that which the Committee had intimated to the promoters as being an improper mode of dealing with the matter, still open to them to urge before the Committee. The position of the opponents now that the Committee were going to consider the case against the preamble entirely at large was this: There was an important paragraph in the preamble which said—"And whereas it is expedient that provisions such as are in this Act contained should be made for the transfer of the undertaking of the Lambeth Company;" and from the phraseology of that preamble, it was evident that the provisions of the Bill were made part of the preamble, so that it might be desirable in the present case to follow the practice of the House of Lords, and settle the provisions of the Bill before giving the decision on the preamble. There arose on that three questions to be discussed. First, there was the question of arbitration, whether it be as originally proposed, or as the Committee suggested as the only form in which it would meet with their acceptance. Then, again, there was the question of how far the transfer of the undertaking was to affect or interfere with the debenture securities of the various Companies—that, too, would be a matter which must be discussed on the preamble. He knew that the promoters said they would give to the debenture-holders pretty much what they asked in the way of security; but if that could not be done, or if there was difficulty in doing it, it became a question of preamble as to the conditions upon which the transfer was to be effected. So, also, was the question of whether the transfer was to be of one Company at a time, or only to be authorized in the event of the Council purchasing the undertakings as a whole, so as to constitute a coherent or homogeneous Water Authority for the Metropolis. The preamble further alleged that the transfer was to be made to the London County Council. He did not understand the Committee to have yet decided that as a preamble question, but only that, in the absence of the suggestion of an alternative Water Authority, they would proceed with the discussion at all events upon the assumption that the London County Council were the only authority asking at present. He submitted that it was quite open to the opponents to say, not that such and such a constitution would be the right one for the Water Authority, because nobody had a Bill before the Committee proposing such a constitution; but they were clearly entitled to say that inherently the London County Council was an improper body to which such a power should be entrusted. The latter point was not so strong in the mouth of those who were to be purchased and extinguished, as in the mouth of those who were to be left alive, and who would be affected by the transfer after it was made; and his view was that the main argument upon that part of the question really rested with the outside authorities who had not agreed with the County Council. In consideration of the sudden cessation of the promoters' case, he suggested that there should be an adjournment to enable the opponents to shape their course, and that those outside authorities who desired to intervene, but who had not yet been present in the discussion, might arrange for their witnesses.

Mr. LITTLER thought that, the discussion having come to so sudden a close, they ought to have an opportunity of looking at the evidence in a different light from what they had hitherto done, and of seeing what points there were that need be met by evidence, and what were matters of argument. Such a course would make a great deal of difference in the time of the Committee. Notwithstanding that Mr. Balfour Browne considered he had made out a *primâ facie* case, he would have to look with a microscope to see it, though he could not say there was none; but it would be undesirable to launch at the heads of the Committee a number of witnesses, when possibly they might come to the conclusion that few or none would be necessary.

Mr. PEMBER stated that he appeared for the Lambeth Company, whose property was in question; and while he thoroughly endorsed all that had fallen from Mr. Pope, he would like to emphasize one or two points which that Company desired to raise, without for the moment opening his case or arguing upon them. He also appeared for some of the other Water Companies, and for the Kent County Authorities. The four Companies which he represented, and also the Kent authorities, wished to raise at the very earliest period the question whether the London County Council was inherently the proper body to whom the transfer should be made, although they did not propose to put any alternative scheme before the Committee. He also desired to raise the question as to the position of the debenture-holders in the purchase. Further, he wished to put very strongly indeed before the Committee the absolute impropriety, or inadmissibility, of allowing the purchase of one or more Companies without allowing the purchase of the whole; and he thought he would be able to show that this would be contrary to one of the express decisions of Sir Matthew White Ridley's Committee. Lastly, he desired to put before the Committee the question of transfer before payment, which was equally a matter of preamble. One of the strongest terms of the Bill was that the Council proposed to take away his property without paying him the purchase-money, or even before they had the money themselves, because, as he suggested the other day, thirty or forty millions of money did not grow upon every gooseberry-bush in the City of London. Mr. Balfour Browne, in his opinion, congratulated himself somewhat prematurely upon having correctly interpreted the decision of the Committee; but he would not now argue that point. While endorsing the desire for an adjournment, he held a very strong view that the various county authorities' opposition should precede that of the Water Companies; for, while they were not the same out-and-out opponents of the Bill, they were also to some extent hostile to the Water Companies, and it would not be fair that the latter should have behind them an opposition which might involve a certain review of their own case. As to the order in which the Water Companies' cases should be taken, he thought the Lambeth Company, being the one most affected, should choose its own position.

Lord ROBERT CECIL, for the Middlesex County Council, agreed that it would be convenient that the case of the local authorities should be heard before that of the Water Companies.

Mr. BALFOUR BROWNE said he had not the least objection to an adjournment. As to the postponement of the preamble, he did not care whether the Committee declared it proved at the close of the opponents' case, or postponed it. But, of course, it would be understood that they were discussing clauses; and he should say in the other House that, though the preamble was postponed, the Companies did discuss clauses, and therefore to that extent gave way on the principle by making the best terms they could.

Mr. LITTLER said that, as the preamble was postponed for the convenience of the Committee, it ought to be understood that the opponents were not to be prejudiced in the other House.

The CHAIRMAN said that it had struck him, in reading the Bill, that the construction of the preamble in the respect to which Mr. Pope had called attention was, he would not say unusual, but at any rate peculiar. It appeared to him, if there was no objection on the other side, that the course proposed by Mr. Pope would be convenient; but he would like to consult his colleagues before coming to a conclusion upon it. While he thought it should not prejudice the opponents in the other House, they had no control over that matter; and therefore Mr. Pope's clients would adopt that course on their own responsibility.

The Committee-room was then cleared; and after the Committee had been engaged in consultation for some time,

The CHAIRMAN said, before informing Counsel of the decision at which the Committee had arrived on the three subjects which were brought under their notice, he wished to refer to an expression which fell from Mr. Pope, for fear of there being any ambiguity. Mr. Pope said that the decision arrived at led up to the necessity that the special directions to be given to the Arbitrator should be struck out. No doubt Mr. Pope intended to refer to the concluding paragraphs.

Mr. Pope: Clearly.

The CHAIRMAN said that Mr. Pope went on to say that they should be struck out; and there should be left the general question to be addressed to the discretion of the Arbitrators. Upon that, he only wished to recall the exact words of the decision at which they then arrived: "The Arbitrator should, in determining the fair and reasonable value of the undertaking, have regard to all the circumstances of the case, as provided in lines 30 and 31, page 7, clause 6;" and they added—"The Committee would be willing, on consideration of the clause, to introduce, if necessary, other general words," and so on. Up to the present, all that they had done was to declare, as regards the subsequent part of the clause, that they were not disposed to allow the provisions to remain in the Bill. With that, he should say, the petitioners at all events could find no fault. He ventured to suggest that the most convenient point for them to raise any objection as to other parts of the decision, would be when they came to clause 6. As to the order in which the opponents' case should be heard, he thought they might settle that among themselves; but he agreed that it would be desirable that the authorities should begin first, and the Companies should have the last word. After the Committee had heard the case for the petitioners against the Bill, they could then decide whether there was any reason for departing from the usual course of "the Committees of that House in respect to proceedings on preamble. The Committee thought it better to sit on Tuesday next, though they were, of course, unwilling to refuse any application for further time that might be made on one side or the other; but at that period of the session, they would not be justified in allowing more delay than was absolutely necessary.

The proceedings were then adjourned till the following Tuesday.

Increased Storage at the Gravesend Gas-Works.—The Gravesend Gas Company have concluded a contract with Messrs. C. & W. Walker for the construction of a holder 126 feet in diameter, and a capacity of half a million cubic feet. The work will be carried out under the supervision of the Company's Engineer (Mr. J. Davis).

East Surrey Water Company.—The report of the Directors of this Company for the year ending the 25th of March last, which was submitted to the proprietors at their annual general meeting last Saturday, states that 305 new customers were added during that period. The sum available for apportionment upon the shares for the whole year was £6990; but an interim dividend of 2½ per cent. had been paid, and there remained the further 2½ per cent. to make up the 5 per cent. recommended by the Directors. After payment of this, there was left a balance of £699 to be carried forward. To show the estimation in which the Company's £10 shares are held, 2000 were offered for sale by tender in September last; and applications were received for four times the number. The allotment resulted in premiums being received to the extent of £3752. Mr. E. Easton, who was for many years the Chairman of the Company, has resigned the position and his seat on the Board. He has now been succeeded by Sir Myles Fenton on the directorate, and in the chair by Sir F. Bramwell.

LEGAL INTELLIGENCE.

CARLISLE COUNTY COURT—Tuesday, June 4.

(*Before His Honour Judge* STEAVENSON.)

Atkinson v. The Corporation of Carlisle—Damage Caused by a Burst Water-Pipe.

This was an action brought to recover damages for injury caused by water escaping from a burst water-pipe. The facts are amply set forth in the judgment delivered by his Honour.

His HONOUR said: The plaintiff carries on business in Carlisle, and is supplied with water for his premises by the defendants. The plaintiff's assistant (Hill) left the shop at 7.45 on April 11; being the last to leave. At that time the water was turned off by the stop-tap in the street just outside plaintiff's door. Next morning, Hill returned to the shop; being the first to enter. He then found the stop-tap in the street had been opened, so permitting the water to enter his master's premises. It had escaped through a burst pipe, and caused the damage for which this action was brought. During the night a man named Stordy, in the defendant's employment, in the course of his duty was examining the pipes, and in particular examining by listening for any waste of water from leakage. He had with him a key, which would turn this tap in the street. In my opinion, he found the tap turned off, and turned it on. It was suggested that some mischievous person had turned it on. There was, however, no evidence of this. In turning the water on, and so leaving it, I am of opinion that Stordy was guilty of negligence for which the defendants are liable. It is not illegal for the plaintiff to turn this tap off; and there is no law which compels him to have a second stop-tap within his premises. At any rate, no section of any Act or any bye-law was quoted to me on these two points. A water consumer might desire the water turned out of his premises for many reasons—*e.g.*, frost, a sudden burst which there had been no time to repair, or alteration of pipes taking time to complete. Why, then, should such a consumer not use the simple means at his disposal to shut off the water, by turning the stop-tap in the street? If, then, the water was lawfully turned off, what duty or right have the defendants to turn it on without, at any rate, informing the person whose premises would be affected thereby? This is exactly the fact in this case. Stordy found the water off, and turned it on, by which means he was enabled to detect by the sound that there was a leak. Having so detected the leak, he left the water on, and so caused the damages claimed in this action. Stordy was guilty of negligence in two respects—in turning the water on when he ought reasonably to have assumed it was turned off for some good reason; secondly, in not leaving it as he found it when he might reasonably have concluded it must have been turned off to avoid the further leakage he had himself detected by turning it on. One other point was taken for the defendants—viz., that the plaintiff had left the broken pipe within his premises too long unmended. I am of opinion that from January to April was not an unreasonable time considering the almost continuous frost during that period, and the fact that the plaintiff had been trying to persuade his landlord to discontinue the consumption of water in this house, as the plaintiff had an ample supply in an adjoining house for domestic purposes; the water in the house in question being used only for domestic purposes. I find for the plaintiff damages (which are not in dispute) £12 15s. I am informed this case raises an important point of law. That being so, and as each party wished to appeal if my decision was adverse, I grant leave to appeal.

On the application of Mr. CAVANAGH (who appeared for plaintiff), His HONOUR granted costs on the C scale, and allowed Counsel a conference.

Extension of the Gas-Works at Bergen-op-Zoom.—The Corporation of Bergen-op-Zoom, Holland, have just voted a sum of 100,000 florins for the purpose of extensions at the gas-works. They comprise a telescopic gasholder, of about 250,000 cubic feet capacity, which is to be ordered at once and completed before next winter. The plans have been prepared by the Gas Engineer (Heer W. C. P. Asselbergs), who will superintend the extensions during their progress.

Salford Corporation Gas Supply.—The annual report of the Gas Committee of the Salford Corporation shows that the consumption of gas has greatly increased. The gross profits amount to £32,507; leaving, after making allowances for interest, depreciation, &c., a net profit of £25,010. The Committee propose to pay out of this sum a contribution of £2089 towards the borough redemption fund. The report was adopted at last Wednesday's meeting of the Council.

Coal Contracts for Manchester.—The Gas Committee of the Manchester City Council have made their purchases of coal and cannel for the ensuing year on very much better terms than before. Last year they effected a saving of £18,000 on the purchase of coal; but this year a very considerable advance upon that has been secured. The prices which were offered were so low this year that the Committee considered it advisable to purchase about 150,000 tons for the second year. They have also adopted a new precedent in not purchasing such a large quantity of high-priced cannels, and have gone more in the direction of securing high-class coal.

Widnes Corporation Gas and Water Undertakings.—The minutes presented by the Gas and Water Committee at last Tuesday's meeting of the Widnes Town Council stated that the Borough Accountant had submitted the profit and loss account on the gas and water undertakings for the year ending March last. It exhibited a profit on the gas account (excluding £1289 for public lighting) of £2219; and a profit on the water account (excluding £660, the cost of improvements at Pex Hill) of £1328. In moving the adoption of the minutes, Mr. Bullough observed that he thought it was a matter of congratulation that the profits on the gas-works were so large; and he expressed the hope that the Council would in the near future see their way to reducing the price of gas. Mr. Davies, who seconded the motion, said he should be pleased if, instead of reducing the price, the Council could devote £2000 or £3000 a year to the reduction of the rates. The minutes were confirmed.

MISCELLANEOUS NEWS.

GAS AND WATER PROVISIONAL ORDERS (SESSION 1895).

Consent of Local Authorities Dispensed With.

In compliance with section 4 of the Gas and Water Works Facilities Act, 1870, the Board of Trade have lately reported that they have granted certain Provisional Orders—viz., those relating to Llanberis, Mid Kent, and Newark—notwithstanding that the consent of some of the authorities concerned was withheld. The Board furnished the following particulars in regard to these matters; the local inquiries mentioned having been already reported in our columns.

The application made by the Llanberis Gas and Water Company, Limited, was for authority to maintain and continue their existing gas and water works, to construct additional water-works, to manufacture and supply gas, and to supply water within the parish of Llanberis, in the county of Carnarvon. Objections were lodged by the Llanberis Parish Council, the Gwyrfai Rural District Council, and the Carnarvonshire County Council, mainly on the ground that the granting of the Order would prejudice the question of the purchase of the undertaking and the supply of water by the Rural District Council; and that the water-rates proposed to be charged were too high. The Board of Trade appointed Lieut.-Col. H. A. Yorke, R.E., as Commissioner to hold a public inquiry at Llanberis with respect to the application, and to report to them in the matter. To meet the objections of the Local Authorities as to purchase, the promoters offered to make certain amendments in the purchase clause, and to provide that, in the event of the purchase of the water undertaking, or of both undertakings, no additional price should be awarded by reason of the granting of the Order, except the expense of its promotion. Colonel Yorke reported that, while giving due weight to the views of the several authorities, he did not think it would be just to the existing Company to refuse to grant the Order, as they were willing either to afford a proper supply under statutory obligations, or to sell the water-works (and, if desired, the gas-works also) to the Local Authority. He also reported that, with regard to the gas-works, no opposition was made by any authority or person to the granting of the Order. Subject, therefore, to certain amendments of the purchase clause, and to a reduction of the water-rates proposed to be authorized, Colonel Yorke recommended that the Order should be granted; and the Board thereupon decided to adopt this course, subject to certain amendments and modifications.

The Mid-Kent Water Order was applied for by the Mid-Kent Water Company, Limited; its objects being to empower the Company to maintain and continue certain works, to construct additional works, to extend their limits of supply by including the parish of Aylesford, and to raise further capital. The authorities concerned in the application were four in number—viz., the Halling and Aylesford Parish Councils, the Malling Rural District Council, and the Kent County Council. The first-named Council and the Kent County Council agreed to the application. The consent of the Malling Council could not, however, be obtained; and the Aylesford Council objected to the Order being granted. In these circumstances, the promoters applied to the Board of Trade to dispense with the consents of these two bodies The Board accordingly appointed Colonel Yorke to hold a public inquiry at Aylesford with respect to the application; and he reported that he was of opinion that it would be for the public advantage of Aylesford, and more especially of Eccles, that the Order should be granted. He therefore recommended that the consents withheld should be dispensed with. He further stated that he thought it would be desirable to modify clause 5 of the Order in such a manner as to make it incumbent upon the Company to take the necessary steps to furnish a sufficient supply of water in Aylesford within one year from the date of the Order, or within two years of that date, by the permission of the Board; and that, in the event of the Company failing to supply within the period specified, the powers conferred by the Order should be forfeited. Acting on the Commissioner's recommendations, the Board decided to dispense with the consents of the Aylesford and Malling Councils, and to grant the Order, with a special clause providing that, if at the expiration of one year, or two years, as the case might be, the Company were not furnishing a sufficient supply of water in Aylesford, their powers within the parish should absolutely cease and determine. Such other alterations in the terms of the draft Provisional Order as seemed fit were also made.

With regard to the Newark Order, the application was made by the Newark Gas Company, who have statutory powers under the Newark Gas Act, 1866, for authority to raise additional capital, to extend their limits of supply, to construct and maintain additional works, and for other purposes. Some of the local authorities objected to the application; while others withheld their consent. Objections were also lodged by owners of land adjacent to the site of the proposed works. The Board of Trade appointed Major Marindin, R.E., C.M.G., as Commissioner to hold a public inquiry at Newark with respect to the application. He reported that the promoters had made certain modifications in their proposals to meet some of the minor points; but that the general objection of the Corporation of Newark to the granting of the Order on the ground that they wished to have in their own hands the power to light the borough, and were prepared to purchase the undertaking on fair terms, had not been removed. The Corporation urged that a clause should be inserted in the Order, giving them authority to purchase the undertaking compulsorily at any time within two years after the passing of the Order. Major Marindin stated that, inasmuch as there was no precedent for the insertion of such a clause in any Gas Bill or Provisional Order, except by agreement beforehand, he was of opinion that the clause should not be inserted. He also recommended that the area of supply should be limited as proposed in the amended application; and that the Order should provide that the Company should not supply gas in any of the parishes within the extended limits until the Local Authority had signified their consent. Subject to certain modifications and amendments, Major Marindin recommended that the Order should be granted; and the Board, having considered the report, decided to give effect to the recommendations.

THE HAGUE GAS-WORKS.

Report on the Working for the Year 1894.

We have received the report of the Committee of Administration of the municipal gas-works at The Hague, on the position and working of the gas undertaking during the year 1894. We abstract from it the following particulars.

The quantity of gas made during the past year was 16,623,739 cubic metres (587 million cubic feet); being an increase of 3·51 per cent. as compared with the preceding twelve months. The loss from leakage was, however, less than in former years, being 7·14 per cent. of the make in 1894; consequently there was really a greater increase (4·92 per cent.) in the net available production. The price of gas, both for public and private lighting, was 7c. per cubic metre (3s. 3½d. per 1000 cubic feet) throughout the period covered by the report; but a reduction to 6½c. has been promised for the current year. The average illuminating power of the gas, as tested by the Letheby-Bunsen photometer, was 15·71 English candles. The contracts for coal entered upon in April for the ensuing twelve months were made at an average price of about 13s. 6d. per ton. Carburine was obtained from the Gas Lighting Improvement Company, Limited; and some American rosin was also purchased at 95s. per ton for enrichment purposes. A sum of nearly £23,750 was handed over to the Municipality, chiefly in payment of the annual impost of 2s. 6d. per metre of ground traversed by mains. The cost of production was slightly lower than in any previous year; while the length of mains laid had increased at the end of December to 92 miles 260 yards. The number of consumers at the close of 1894 was 11,708, against 11,241 at the corresponding time in 1893; and the number of public lamps was 3349, as compared with 3234 in the preceding year. The consumption for all purposes per head of the population was 3024 cubic feet. Coke realized a slightly higher amount than in 1893; but the total received for the other bye-products was less. In December last, the works contained 62 settings, with a total of 468 retorts. The largest make in one day was 2,790,000 cubic feet—on Dec. 19. The average make of gas was 10,030 cubic feet per ton of coal carbonized. A substantial profit on the year's working is carried forward; and it proves, with the increased consumption and diminished cost of production, that 1894 was one of the most prosperous years since the gas-works were taken over by the municipal authorities in 1875. Heer J. E. M. Kros is the present Manager of the Works.

THE INSPECTION OF GAS LIQUOR AND OTHER WORKS UNDER THE ALKALI ACT.

The Sub-Inspectors' Reports.

In the JOURNAL for the 28th ult. (p. 1154), we gave extracts from the report of the Chief Inspector under the Alkali, &c., Works Regulation Act, 1881 (Mr. A. E. Fletcher), for the past year. We now notice the reports by the Inspectors of the various sub-districts.

Beginning, as usual, with Ireland, which is under the supervision of Mr. E. G. Ballard, F.I.C., we find that there are 25 sulphate of ammonia works, and 6 works for the distillation of tar. The number of visits paid last year was 135; and of tests made, 65. Mr. Ballard says the sulphate of ammonia works are carefully conducted. Improvements are being carried out at some of them at his suggestion, but are not yet completed. The works are in good order. Taking all the places where the sulphate of ammonia is made in Ireland, the number of works with the continuous system of distillation is 12; with the intermittent system, 15; where the sulphuretted hydrogen is absorbed in oxide purifiers, 16; and where it is burnt, 11. There were 2707 tons of sulphate of ammonia made in the district during the year. At the works where tar is distilled, proper arrangements have been adopted for dealing with the noxious vapours evolved. There is, however, a class of works registered as tar-works, where roofing felt is made. These have needed some study, in order to arrive at a practical method of dealing with the vapours which arise from the machines where the felt is soaked with the melted mixture of pitch and tar, or pitch and creosote oil—the latter causing the sheds to be filled with a most pungent and irritating vapour.

In the North of England District, of which Mr. B. E. Smith, F.I.C., F.C.S., is the Inspector, the number of registered works is 118; and to these 619 visits were paid last year. The number of plants for the manufacture of sulphate of ammonia at work in the district is 43—an addition of four during the year. The quantity of sulphate produced was 6470 tons, against 6320 tons in 1893. The new works are all small, and the liquor produced in them was formerly consumed at other works in the district; consequently they do not practically add to the output. Patent coke-producing works made 813 tons of the total output. The foul gases are dealt with as follows: In 28 works, they are absorbed by oxide of iron; in 3, they are decomposed by the Claus process; in 2, used to remove arsenic from sulphuric acid; in 8, burnt in the retort-flues or under the boiler fires; and in 2, burnt in kilns for making sulphuric acid. There are eight works in which the distillation of coal tar is carried on. In all, with the exception of two small ones, which are very intermittent in their operation, the gases given off during the process of distillation, and those also which are thrown off when the pitch is run, are prevented from escaping into the air. The method employed is to conduct them by means of a pipe, with water-seal, to either a boiler or a still fire, and there allow them to burn.

In the district embracing Cheshire, North Wales, and part of Lancashire, Mr. E. G. Ballard reports that, with one exception, all the sulphate of ammonia works were carefully conducted last year; and in the exceptional case, a prosecution is going on. Some of these works are covered by certificates for other branches of manufacture; but, taking them together, there are 20 working on the continuous system of distillation, 8 on the intermittent system, 18 absorb the sulphuretted hydrogen in oxide of iron, 9 burn it either under the boiler fires or in the retort-flues, and in one case it is converted into sulphur in a Claus kiln. The total quantity of sulphate manufactured in the district during the year (excluding the Widnes and Runcorn sub-district) was 3280 tons. Mr. Ballard reports that the works for the distillation of tar continue to be carefully conducted. A full description of the various methods adopted for dealing with the noxious vapours was given in the report for 1893. A few improvements have been made; but beyond these there is but little change to record. The workmen have often told the Inspector how much pleasanter the yards are to work in since the gases have been prevented from escaping into the atmosphere. There are only five tar-works registered as such in the district; but, altogether, there are 15 works where tar is distilled—10 being already covered by other certificates.

In the Widnes sub-district, there are three works for the production of sulphate, and one for making muriate of ammonia; the total output of the two salts being equal to 942 tons of sulphate. All the works were well conducted, and kept in excellent condition. At one of them, a perfectly new sulphate house and plant has been put up equal to producing 2 tons of sulphate per diem, in place of the old one of one-third this capacity. The stills employed are those of Messrs. R. & J. Dempster and Co., Limited, which have the advantage of giving increased area of contact between the liquor and the steam. For dealing with the foul gases evolved from the saturator, what ought, in Mr. Ballard's opinion, to prove a very efficient apparatus, has been provided, composed of scrubbers or condensers, and oxide purifiers of ample capacity. The object of the scrubbers is not merely to dry the gases before they are passed into the purifiers, but to recover any ammonia that may escape from the saturator; and, as the overflow from the scrubbers is placed at a higher level than the saturator, the condensed liquors can either be run back there, or forced again into the still by means of the lime-pump. There are two oxide of iron purifiers, the capacities of which are 607 and 455 cubic feet respectively, fitted with a valve arrangement for working them either separately or together. In each purifier the oxide is placed in two layers, each 2 ft. 6 in. thick; the intention being to revivify the oxide *in situ* by means of air forced through the purifiers by a small steam-injector. Mr. Ballard reports that the new plant belonging to the Runcorn Gas Company, which has been added to the register, is very well designed, and most substantially constructed; having a capacity of a ton of sulphate per diem.

Mr. R. Forbes Carpenter, F.I.C., has the supervision of the district comprising East Lancashire and part of Yorkshire; and he reports as follows in regard to gas liquor works: "There was only an addition to the register of one works during the past year. The total quantity of gas liquor worked up into sulphate and muriate of ammonia, as well as into liquor ammonia—crude, refined, and anhydrous—is equivalent to 24,484 tons of sulphate. To exhibit results comparative with those in 1893, I append the following table:—

	1894. Tons.		1893. Tons.
Total quantity of liquor distilled equivalent to sulphate	24,484	..	24,320
	Per Cent.		Per Cent.
Proportion distilled to liquor ammonia	16·1	..	15·5
Proportion of sulphate and muriate made by continuous processes	96·7	..	94·6
Proportion of liquor ammonia made by continuous processes	86·7	..	79·5
Method of dealing with foul gases—			
Sent to vitriol chambers	34·0	..	32·1
By Claus process	10·4	..	12·5
Absorbed in oxide of iron or lime	47·6	..	47·7
By other methods	8·0	..	7·7

No changes of great importance, as regards the method of dealing with the gases evolved, have to be recorded, though the Claus process has been adopted at one more works that started with oxide purification. It is impossible to apportion more than approximately the percentage going to vitriol chambers, as in one large works the balance only of the gases goes in this direction; the decomposition of carbolate of soda by the carbonic acid contained in the gases being the first use to which the foul gases are put. For this latter use, the sulphuretted hydrogen has, of course, first to be removed; and this is done in closed oxide of iron purifiers similar to those in use in gas-works. The suggestion made in the report for 1893, that purifiers should be aërated before emptying, by using a Körting or similar air-injector (the steam used preventing undue heating of the oxide) has been adapted at one works to the continuous regeneration of the oxide while working the sulphate plant; and at another, to that of intermittent revivification during the night—the sulphate plant working by day only." At the close of Mr. Carpenter's report for 1893, he referred to the first prolonged trial of continuous revivification during work. In his present report, he is able, through the courtesy of Mr. T. Duxbury, who was conducting the trial at the Darwen Corporation Gas-Works, of which he was then Engineer, to supply some additional particulars in regard thereto. The results, viewed as a whole, are as follows: Cubic capacity of oxide in the purifier, 311 feet; sulphate made in 24 hours by continuous process, 15 cwt. 3 qrs. (dry weight); cubic feet of air passed through during (32) days of working, 5800 maximum, 300 minimum—or an average of 2081; cubic feet of air passed through when the plant was stopped, 80,500. Mr. Carpenter deals at some length with this matter; his remarks being as follows:—

"At the meeting of The Gas Institute in July, 1894, Mr. Dexter, of Winchester, communicated a paper giving a detailed report of results obtained of continuous revivification of oxide in the (closed) gas-purifiers at his works by admission of air, coupled with a certain proportion of steam. He very clearly showed how, with air admission only, the temperature of the purifier rose, and the stream of gas was equally raised in temperature—its capacity for carrying moisture rising likewise; so that in time the oxide would be deprived of the water necessary for the purpose of revivification, and finally, in consequence, be caked and aggregated together until its back-pressure necessitated the isolation and changing of the purifier. This paper clearly brought out the cause of the back-pressure, and its cure by the concurrent admission of water vapour with the air, so as to keep present in the oxide moisture enough for the purposes of the reaction, and replace the loss of that carried away by the gases passing from the purifier at a higher temperature than that at which they entered. The principle and method are exactly applicable to the conditions existing in sulphate of ammonia purifiers, where hitherto back-pressure has been the cause

necessitating change of purifier, if, indeed, the oxide had not fired through local overheating. On drawing his attention to this paper, I found Mr. Duxbury had already for himself been led to make experiments in this direction; having noticed that he got the best results when the oxide was wet (after rain). He is certain that with this method the purifiers ran from three to four times as long without needing change. On the occasion of my last visit, the fan had been disconnected, and a temporary steam air-injector was in use. The temperature of the purifier showed the activity produced by the method; and from the surface of the oxide, there was no appearance of vapour of water in the issuing gases. I think there is every promise that this method may prove of real service to works depending on the oxide method of purification, where the cost of frequent emptying and refilling entails considerable expense.

"As regards disposal of the water passing from the condensers—known from its offensive smell as 'devil water,' in gas or vitriol works using spent oxide, an easy method exists of making this innocuous and fit to run into the drains. It consists of having two vats, to be used alternately, filled with spent oxide, through which the water can filter. Often sufficient ammonia is recovered in the wash water to make the process, when systematically conducted, a paying one.

"On reference to the table showing the percentage of gas liquor distilled for sulphate and muriate manufacture, by continuous and intermittent processes respectively, it will be noticed that the former continues to increase in favour with manufacturers. In no single case has the principle been abandoned when once adopted. It is natural to infer that considerable economies are found to result, as well as better control over the foul gases evolved. There are many forms of continuous still; but most are variants, in greater or less degree, of the Feldmann still, in which the hot vapours and steam, in passing upwards, bubble through thin films of liquor on trays superimposed over a lime chamber—the liquor descending being first deprived of its free ammonia, and, subsequently to the lime chamber, of its fixed ammonia on more trays of similar type. Success depends on the subdivision of the bubbles of vapour; and various devices have been adopted to better attain this object, and at the same time to diminish the risk of clogging up, either with tarry matters or after the lime chamber, with carbonate and sulphate of calcium. From time to time, it is found necessary to take the whole still apart, and chip off the deposit. A break in the manufacture occurring during the summer gives time and opportunity for this. In a new still patented by Messrs. Peter Spence and Sons, this type is departed from; and the old principle of surface contact is again adopted. The still, constructed of steel, is greatly simplified thereby. Access to remove obstruction, should any occur, is rendered extremely easy; and the quantity of gas liquor passed through in a given area is very largely increased. The gases, being in this instance used, after cooling and drying, to contribute sulphurous acid to the vitriol chamber, come off with great regularity; and no hanging up or priming of the liquor has been noticed. The height of the still, with its 25 trays and lime chamber (27 feet), is perhaps greater than usual, but the superficial area (9 feet by 3 feet) is smaller in proportion to the height. The rectangular form of still gives a great amount of travel for the liquor; the depth on the trays being ¾ to 1 inch. Some 70 tons of sulphate have been made in one saturator in 94 hours, at the rate of about ¼ cwt. per minute. Economy of fuel is claimed; and the loss of ammonia (less than 0·02 per cent.) is small."

Mr. Carpenter goes on to refer to the arrangement devised and patented by Mr. T. Holgate, of Halifax, for the preparation of caustic ammonia in solution from gas liquor, and the use of the liquor so treated for the purification of coal gas. This matter formed the subject of Mr. Holgate's paper at the Institution of Gas Engineers, as given in the JOURNAL for the 28th ult. With regard to tar-works, the number now scheduled in Mr. Carpenter's district is 38; being an increase of three during the past year. At its close, there were remaining only three single-still works, in which no provision was completed for dealing with the gases from the still-worm ends. As regards methods of getting rid of the foul gases, 27 works burn them, preferably in the steam-boiler fires. Mr. Carpenter cannot recommend the still fires, as these are drawn at the close of the operation, before the splitting up of thio-compounds in the final anthracene stage is completed. Four works absorb the gases in oxide of iron; two, in lime; and two, in milk of lime, or lime water. Three only have as yet no method complete. In the case of the largest tar-works, he tested the gases after combustion, and never found a trace of sulphuretted hydrogen; and the average total acidity as sulphur trioxide was only 0·29 grain per cubic foot from the steam-boiler and tar-still fires, with a maximum of 0·41 grain. Many use heavy oil seals for washing the gases before being further dealt with. In one case, the gases pass with those from the sulphate of ammonia plant to oxide purifiers; and as much air was drawn in by the exhauster at the tar plant, a slight explosion occurred at the first purifier.

In the South Midland district, of which Mr. E. Jackson, F.I.C., F.C.S., has the supervision, there are 71 works registered for the manufacture of sulphate and muriate of ammonia and the concentration of gas liquor. One sulphate plant was stopped during the year; and three additional works were registered. In some works, the purifiers were found occasionally out of order; but the defects were at once remedied. This occurred either where new oxide had been used in the purifiers, or where it had been nearly spent. Mr. Jackson points out that it is extremely important that the purifier walls should be carefully built. The bricks—preferably Staffordshire blue bricks—should be well laid in cement; and a cement lining inside is often necessary. Where these precautions have been neglected, the noxious gases have in a very short time come through the joints in the brickwork. This has taken place in one or two new works; so that it has been necessary to stop the work and rebuild. In two cases an outer wall was put up round the existing purifier, and a space left between the old wall and the new one, which was filled in with Portland cement. Hard pitch can also be used in a similar way, with satisfactory results. Iron purifying vessels are more durable, and are in use in some works; but brickwork, if well constructed, can be made quite gas-tight. The cost of emptying the oxide purifiers varies considerably. It is less with the continuous process; and the cost for labour, where it has been ascertained, in one or two places amounts to about 1s. per ton on the sulphate produced. By the intermittent plan, as much as 3s. is the cost in one works. Revivification *in situ* would considerably reduce this figure. In 34 works, representing 92·5 per cent. of the liquor distilled in the district, continuous stills are used; while in 14, with four exceptions (all small works), the intermittent plant is employed. In 48 works, where 33·9 per cent. of the liquor is distilled, oxide of iron purifiers are in use for arresting the sulphuretted hydrogen. In nine works, where 40·2 per cent. of the liquor in the district is distilled, the sulphuretted hydrogen is burnt for the production of sulphuric acid. At two works, both lime and oxide of iron are used in the purifiers; but at one, lime only is employed. In four, the liquor does not contain sulphide of ammonium, and consequently no sulphuretted hydrogen is discharged. In five works, representing 15·6 per cent. of the liquor distilled, the sulphuretted hydrogen is treated by the Claus process. The average quantity of sulphur recovered by this plan per ton of sulphate of ammonia is 77 lbs. Mr. Jackson alludes to the disposal of the spent ammoniacal liquor—a question which he says has lately received increased attention in the Midlands. The elimination of the "devil water," which could either be returned to the ammonia still or be used again in the scrubbers, has not always been sufficient. Mr. Belton, of Shrewsbury, had to face this difficulty; and, in conjunction with Messrs. Davis Bros., of Manchester, he succeeded in removing it. Mr. Carpenter describes the process, which, it may be remembered, was brought by Mr. Belton under the notice of the Midland Association at their meeting in October last year.* The number of works in this district for the distillation of tar is 23—the same as in 1893; and in most cases more attention was given to the running off of the pitch, and allowing it to remain as long as practicable in the cooling-vessels.

The South-West of England and South Wales district is under the supervision of Dr. Fryer. In it there are 70 works where the manufacture of muriate and sulphate of ammonia is carried on. He reports that the works generally have been kept in good repair; and, with one or two exceptions, the purifying arrangements were found satisfactory. One new works was registered in the year; and the sulphuretted hydrogen is absorbed in an oxide of iron purifier. The total quantity of ammoniacal compounds produced during 1894 was 7280 tons. The distillation of tar is carried on at ten works in the district; and the methods of dealing with the uncondensed gases from the tar-stills, the temperature at which the pitch enters the bays, and other details, differ greatly at the various works. At several works, the gases are led to beds of oxide of iron, in which the sulphuretted hydrogen is decomposed. When the pitch is allowed to flow direct into the pitch-bay, or open shallow tank, acrid and irritating fumes arise; and these are often carried some distance, causing considerable nuisance in the neighbourhood of the works. Dr. Fryer reports that at each works a closed vessel is provided, in which the pitch is allowed to cool to a certain extent before flowing out into the pitch-bay; and at one, the air charged with pitch vapours from the coolers, is led away and condensed. The owner is well satisfied with the experiments he has so far conducted.

In the south-eastern counties, Mr. F. Napier Sutton, F.I.C., had under his supervision last year 83 works for the manufacture of sulphate of ammonia; 65 of them belonging to gas companies. The proportion of sulphate manufactured amounted to 72·7 per cent. of the entire product. The total quantity of ammoniacal compounds produced during the year was 40,344 tons, calculated as sulphate of ammonia. This is an increase of 945 tons on the make in 1893; and it is the largest yield that has yet been produced by this district. Two new works were registered during the year; one of them belonging to a large London Gas Company, and the other to a small provincial one. In the latter case, the intermittent system of distillation is used, with oxide purification. The methods adopted in the different works for dealing with the sulphuretted hydrogen evolved do not show any great change; but in a few instances, the methods have been altered. A very large proportion of the sulphuretted hydrogen is utilized for sulphuric acid manufacture—amounting in the past year to 59·4 per cent. of the whole. Of this, 14 per cent. is treated by the Claus sulphur-recovery process, 9·4 per cent. is absorbed in oxide of iron purifiers, and the remaining 17·2 per cent. is destroyed by combustion in the boiler fires, in the flues of the retorts, and in special kilns. The resulting sulphurous acid escapes with the chimney gases into the atmosphere. The Claus process was further extended to two additional works during the year; making a total of eight at which it has been adopted. One of the new plants was at work periodically during the greater part of the year; but the other has only lately been completed. Altogether, nine sulphur kilns and auxiliary depositing chambers are employed. In 48 of the 83 works, oxide purification is used for the treatment of the sulphuretted hydrogen evolved. This method is chiefly in operation at the smaller works, where the annual production varies from 5 up to 150 tons. This is successfully accomplished at one works at which the annual make of sulphate is 250 tons; but most of the works having a larger production than 150 tons use the Claus process. Oxide purification, however, is about to be tried (with intermittent revivification *in situ*) at a new works where the expected make of sulphate amounts to 30 tons weekly and 700 tons annually. This is the largest scale on which oxide purification has been attempted in this district; and, of course, the results will be watched with much interest. Several attempts are being made to prolong the active condition of the oxide by revivification *in situ*. This is done both by a direct and a continuous supply of air (admitted into the foul gas main by steam injection), and by intermittent downward draught of air through the purifiers by connection with the chimney draught when these are out of action. No doubt considerable advantage is obtained by both systems; but sufficient time has not yet elapsed to form a reliable opinion as to which method gives the better results. An attempt has been made to arrive at the average cost of the treatment of sulphuretted hydrogen (1) by absorption in oxide of iron purifiers, and (2) by the Claus process. For this purpose, inquiries were addressed to the managers of some 25 works, at six of which the Claus process is in operation, and oxide

* See JOURNAL, Vol. LXIV., p. 865.

purification at the rest. The capacity and type of the plants at these works vary greatly; some of the stills being intermittent, and some continuous in action. The condensing and purifying power also differs considerably; and in a few cases attempts are made to revivify the oxide *in situ*. Unfortunately, it was found that, in the large majority of the works where oxide purification is employed, no separate account is kept of the oxide used and the labour expended on the purifiers attached to the sulphate plant. In a few cases this is done, or the cost could be estimated closely; and the figures were readily and courteously given to the Inspector. In all cases of oxide purification, interest on capital for condensing plant and purifiers had been charged, and account taken of the value of the oxide used, less the sulphur recovered and labour expended. In calculating the cost of the Claus process, interest on capital outlay, maintenance, and labour, less the value of the recovered sulphur, were included. The following table gives particulars in regard to the works where the sulphuretted hydrogen is absorbed by oxide of iron:—

No.	Method of Distillation.	Sulphate of Ammonia Made per 24 Hours.	Sulphate of Ammonia Made per Annum.	Oxide Available per Ton of Sulphate Produced per 24 Hours.	Cost of Purification per Ton of Sulphate Made.
		Cwt.	Tons.	Cub. Ft.	s. d.
1	Continuous	20	100	384	2 6
2*	,,	33	115	260	1 6
3	Intermittent	..	117	..	3 4
4*	Continuous	30	152	324	3 0
5	,,	33	162	436	5 5
6	Intermittent	5	45	..	7 1
7	,,	7	52	343	3 6
Average cost per ton					3 9

* Means used here for revivification *in situ*.

The following table gives the cost of treating the sulphuretted hydrogen by the Claus process:—

Register Number of Works.	Annual Make of Sulphate of Ammonia.	Cost per Ton of Sulphate of Ammonia Made.
	Tons.	s. d.
2138	669	0 8
2139	1866	1 1
2161	630	0 11½
2265	847	1 1
2294	308	1 1½
Average cost per ton		1 0

Commenting upon the foregoing figures, Mr. Sutton says: "The wide variation shown in the first group of figures is somewhat surprising; but in the extreme cases some explanation can be given. The highest cost is No. 6. The plant is intermittent in action; and the condensing power is much too small. The gases enter the purifier hot, and highly charged with moisture—so much so that the oxide becomes very wet and dense, and requires frequent change before being actually fouled. The available purifying space is not known; but it would be ample under favourable conditions. The obvious remedy is increase of condensing power. In the case of No. 5, the condensing and purifying plant has been very expensively erected; and the former is disproportionally large for the work required of it. Taking the interest at 7½ per cent. on the capital charges for these two items, the cost amounts to 1s. 2¼d. and 10½d. respectively; or, taken together, 2s. 0¾d. per ton of sulphate. The other items given in this case are 9¼d. for the oxide, and 2s. 7d. for the manipulation of the oxide; making up a charge of 5s. 5d. in all. As to the lowest cost quoted (No. 2), the condensing and purifying plants were erected at small cost; but they are very efficient. The purifiers are constructed of concrete made of beach shingle (obtained close at hand) and cement; and revivification of the oxide is carried out very successfully, by alternately connecting the purifiers when out of action with the chimney draught, and so obtaining a slow downward current of air through the oxide. I have reason to believe that, if a larger number of figures could have been obtained, the average cost of oxide purification would have worked out nearer 2s. 6d. than 3s. 9d. per ton of sulphate, as shown by the figures actually quoted. Great uniformity is shown in the cost of the treatment of sulphuretted hydrogen by the Claus process, though the quantity of gas treated at the different works varies considerably. In no case does the process show a profit; but the average cost of 1s. per ton of sulphate compares very favourably with that of purification by oxide. Satisfaction has been frequently expressed at the working of the process by those who have had experience of it. The Manager at works No. 2138 writes: 'It is a very efficient means of dealing with the gas; and I should be sorry to be without it.' The Manager of works No. 2137, who has recently adopted the system, writes: 'By working the Claus process, we have not found it necessary through its use to add to the staff in any degree;' and, again, the Manager of works No. 2294 writes: 'It has worked satisfactorily all the time, and entirely does away with the sulphuretted hydrogen nuisance.'" Mr. Sutton adds that there is no alteration in the number of works distilling tar, or in the number of stills employed. The 17 works have all been in active operation; and they have a total of 118 stills. The large majority of these are 12 to 14 ton "pot" stills; the remainder consisting of five patent horizontal stills of large capacity, and two patent continuous stills. Considerable advance has been made in the methods employed for treating the vapours and permanent gases evolved at the still-worm end, and in minimizing the nuisance produced during the running off of the hot pitch from the stills, especially in those works which, during the first year of inspection, were most backward in this respect. In almost all cases, the means employed are now better understood, and are more regularly and satisfactorily worked by the men in charge. The distillation of tar by Mr. Lennard's continuous still, a description of which appeared in the JOURNAL for Sept. 25 last (p. 604), has been successfully carried on. The original still worked smoothly and well during a great portion of the year. In the summer it was idle for some time, owing to the scarcity of tar at that period; but later on it was constantly at work, distilling an average of 15,000 gallons per 24 hours. A second and larger still was completed in the autumn, and was put in operation. This, Mr. Sutton says, is working in a most satisfactory manner. All the tar obtainable for the works in London belonging to the firm with which Mr. Lennard is connected, will in future be distilled by this system. After another year's acquaintance with, and observation of, the system, Mr. Sutton is sure that great possibilities are before it. That it will entirely replace the intermittent process of distillation is not probable, as small distillers must always exist in localities which do not produce tar in quantity; but there is every reason to believe that it will ultimately, and in the near future, take the place of the intermittent system in large works. The absolute freedom of the process from any evolution of disagreeable fumes, which is so characteristic of the tar-distilling industry, is one of its many remarkable advantages—a feature likely to be appreciated by sanitary and other authorities, as well as by the public at large.

Scotland is, as usual, the subject of a separate report by Mr. W. S. Curphey, F.I.C., F.C.S. He states that the quantity of sulphate of ammonia made last year was 54,013 tons, as compared with 48,510 tons in 1893—a difference of 5503 tons. Of the first-named quantity, 11,447 tons came from gas liquor works. There are now 61 sulphate of ammonia works—an increase of two as compared with 1893. There would have been a still higher production of sulphate, but for the prolonged coal strike, which caused a great restriction of operations for the time among the iron-smelting works, and in a less degree affected also the shale-distillation works. In both of these groups of works, the recovery of ammonia, &c., from what at one time were entirely waste products, has become a most important item in their operations. But for this economy, the manufacture could not in most cases be pursued profitably. The treatment of the noxious gases incidental to the working of gas liquor continued as formerly; but the use of the continuous still is more general. In two gas liquor works, the old intermittent system has given place to the continuous; and in the new ones, the continuous mode of distillation is adopted. In several of the very small works, these gases are burned; in the remainder, the oxide of iron purifier is used, except in two cases, where all the sulphuretted hydrogen is converted into sulphide of iron before the liquor is distilled. The three methods of dealing with the noxious gases given off during the distillation of tar, mentioned in the previous report—viz., destruction by fire, absorption in hydrated lime, and absorption in hydrated oxide of iron—continued in operation during the past year.

BIRMINGHAM CORPORATION GAS AND WATER SUPPLY.

The Working of the Gas-Fittings Department.

It may be remembered that at the special meeting of the Birmingham City Council on the 21st ult., among the questions discussed were proposed increases in the salaries of various officials in the Gas Department. One of the recommendations was that the remuneration of Mr. Barrett, the Fittings Superintendent, should be raised from £350 to £400 per annum. It was resolved, however, that a decision should not be arrived at until the Gas Committee had furnished a profit and loss account of the Fittings Department from 1891 to 1895. This the Chairman (Alderman Pollack) submitted at the meeting of the Council last Tuesday. He said that in 1887—the year previous to the appointment of Mr. Barrett—there was a loss of £249. In 1888, the loss was converted into a profit of £1121; and in 1889 there was a profit of £1149. In the first three months of 1890, when the financial year was altered, there was a profit of £400. The profits for 1891 were £2181; for 1892, £2370; for 1893, £1744; for 1894, £1172; and for 1895, £1838. Mr. Barrett held a most responsible position; and when he was engaged it was on the understanding that his salary should be raised to the maximum of £400, if his services were satisfactory. The Committee were thoroughly satisfied with his services; and he therefore moved that his salary be raised by £50. The motion having been seconded, Mr. Waters said that, looking at the question from a commercial standpoint, he did not think the profits of the last three years warranted them in voting the increase. It did not seem to justify the remark of the Committee that Mr. Barrett had of late successfully conducted the business of the department. Alderman Lawley Parker was of opinion that anyone having a knowledge of manufacturing businesses at the present time would not consider the argument of Mr. Waters a good one to use. Considering the depressed state of commerce during the last few years, the results of the department were eminently satisfactory. Mr. A. C. Osler said, although he was not very friendly to the development of this section of the Gas Department, he should support the motion. He did not consider a salary of £400 too much to give a man who conducted the work as Mr. Barrett did. He not only possessed practical, but a scientific knowledge. Mr. Jacobs opposed the motion, because he objected to the Corporation trading at all. Alderman Baker thought it was not fair to discuss the policy of the Gas Committee over a question of salary. Several other members spoke for, and in opposition to, the recommendation; and on being put to the vote, it was carried by 29 to 17.

The Report of the Water Committee.

Alderman PARKER subsequently moved the approval of the report of the Water Committee, several matters in which were dealt with at the last meeting. Referring to the report which the Committee had caused to be made to them as to the sufficiency of the present sources of supply in the period that must elapse before the Welsh water was available, he said it showed that they had nearly exhausted the local resources; and they were obliged to come to the conclusion that there was even less water available than they anticipated being able to find within the local area. The main recommendation, therefore, of Mr. Mansergh and Mr. Davey was that they should economize the water; and the question of whether or not they would require to make a

further expenditure for local sources chiefly depended upon how far they could reduce the waste of water. The Engineers referred to thought that several gallons per head of the population per day might be saved without limiting the actual consumption of water; and the Committee had already done a good deal towards this by a more rigorous inspection of the waste at night, and by sending out notices to consumers both of measured and unmeasured supplies where there was reason to believe that waste was going on. They had also commenced a house-to-house visitation, and had applied to the Public Works Committee to stop the street watering at night. He feared that, unless the weather changed, it would not be long before they would have to still further limit the street watering in the daytime. With reference to the effects of last winter's frost, careful note had been taken as regarded the circumstances observed in relation to the freezing of mains. Out of 563 miles of mains, only 55 miles were affected by the frost; and only 3¾ miles burst, as compared with a much larger proportion in other districts. None of the mains over 6 inches in diameter burst; and the majority of them were only 3 or 4 inches. In 41 cases, the mains were 2ft. 6in. or more deep; and in one or two instances they were 4 feet deep. The consolidation and state of the roads and protection by the proximity of houses had a great effect; and it seemed really more a question of the circulation of the water than anything else. They had had the bill in for the frost and the gale; and a very heavy bill it was, amounting to nearly £9000, all of which was necessarily charged to revenue, and had to be deducted from the profit carried to the water fund. Referring to the annual accounts and statistics, Alderman Parker pointed out that, though the increase of the water-rents had not reached the percentage anticipated in Mr. Mansergh's tables, they were within £1000 of that amount. The ordinary domestic water supply had increased more than the estimated 3 per cent.; but the trade supplies had decreased—an effect which he attributed to the depression that had prevailed. Dealing with the progress of the Elan works, he referred to the circumstances under which Mr. Gray had retired from active work, and stated that Mr. Mansergh had undertaken the charge of the second section of the scheme upon the same terms as those relating to the works in the Elan Valley.

Alderman Cook, in seconding the motion, remarked that he regarded with apprehension the appeal to the Public Works Committee to restrict their water consumption, especially at this time of the year.

Mr. Lane thought the Committee should report oftener upon a scheme which involved such a large outlay. There was a mistake in the estimates of the Committee of £4500 a year, which would amount, by the time the scheme was completed, to a total of a quarter of a million. He also quoted figures to show that altogether, up to the present, the Committee were out in their calculations to the extent of £140,674.

Mr. S. Lloyd caused some amusement by suggesting that the Committee should get London to take over the scheme, with an undertaking to give Birmingham a supply of 26 million gallons per day free.

Mr. Stevens complained of the long hours worked by the men at the principal stations; and he moved an instruction to the Committee to reduce them within reasonable limits.

Mr. Osler seconded the amendment.

Alderman Kenrick hoped the Committee would consider the matter referred to by the last speakers.

Alderman Parker, in reply, referred at length to the criticisms of Mr. Lane. The cost of pumping had, he stated, been above what was estimated; but that arose through putting consumers who had complained of an insufficiency of water on a higher level supply. As a matter of fact, the cost of pumping was last year £1000 less than in the year before. It was perfectly true that the capital expenditure exceeded the estimate; but this was caused through having to buy some of the estates on the water area earlier than they expected, in order to get rid of dangerous opposition in Parliament. The £4500 mistake had already been fully explained to the Council, although they had not been able to say who was to blame for it. But this really made no difference as to the cost of the Welsh water scheme, and would have had to be paid whether they had gone to Wales for water or not. Mr. Lane was not correct in his statement that the Committee were out £140,000 in their calculations. The Committee believed, generally speaking, that their tables were right; and they were sanguine that there would be no charge upon the rates in connection with the scheme. He concluded by showing that the change from a twelve to an eight hour shift would involve an additional cost of £4000 per annum. The Committee were anxious to reduce the hours, though at present they had not found out how it was to be done. He would promise to bring the matter before the Committee; and if they could devise any scheme, they would submit it to the Council.

The amendment was thereupon withdrawn; and the report was approved.

ELECTRIC LIGHTING NOTES.

At the Meeting of the Commissioners of Sewers last Tuesday, the Streets Committee presented the following report: "From time to time we have had under consideration the question of lighting the minor streets of the City under the electric lighting contracts entered into by your honourable Court in the years 1890 and 1891. These contracts provide (*inter alia*) that all streets, lanes, and courts other than those described as main thoroughfares shall be lighted by means of 906 glow lamps; the prices being fixed at £10 per annum for lamps of 200 watts power, and £5 per annum for those of 100 watts; the right being reserved to the Commissioners, to change or alter any specified lamps as they may direct. With a view to determine the best method of lighting narrow thoroughfares, experiments were made in Aldermanbury and Basinghall Street with incandescent lamps of these capacities. But the result was by no means favourable to this mode of illumination; and a subsequent trial with alternating arc lamps in the latter thoroughfare proved of no practical value. We thereupon instructed Mr. Preece and your Electrical Inspector to formulate a scheme for lighting the minor streets, where possible, by arc instead of glow lamps; and a survey of the thoroughfares in question was made, and plans were prepared by Mr. Voysey with that object. The City of London Electric Lighting Company, however, having intimated their inability to furnish us with any reliable estimate as to the cost of giving effect to the proposal until further experience has been gained on the subject, we submit a report from the Electric Inspector, suggesting that certain experiments should be made to illustrate side by side three different methods of illumination, while every facility will be afforded to him by the Company to check the actual cost of each system. It is proposed to light Bow Lane and the court leading out of it to Bow Churchyard by means of six 'Sunbeam' incandescent bracket lamps, so arranged as to be capable of being switched on and off by the police. Watling Street, Bread Street, Friday Street, and Old Change are to be lighted by means of eleven centrally hung arc lamps. The thoroughfares selected for the experiments, being contiguous, will afford the opportunity of practically testing the comparative efficiency and value of the alternating and continuous current systems of arc lighting, as well as of the method of illumination by means of 'Sunbeam' incandescent lamps, and of obtaining information as to the respective costs of running the same; the City of London Electric Lighting Company having agreed to charge only the actual cost to them of the work, which they estimate at about £386, independently of the charge for running the lamps, which your Electrical Inspector is of opinion will be £1 per night. We beg to recommend that the proposed experiments be agreed to; and that it be referred back to us to have the same carried out accordingly." The consideration of the report was adjourned.

After much delay, the question of an electric lighting installation for Chester has assumed a definite shape. At the meeting of the Council last Wednesday, it was agreed to accept the offer of Thomas Parker, Limited, of Wolverhampton, to supply the necessary plant for £14,200, exclusive of buildings (which are estimated to cost £3000), and to run it for a period of one, two, or three years.

The Hull Corporation Electric Lighting Committee have received the sanction of the Local Government Board to the borrowing of an additional £2800 for electric lighting purposes. The Committee have also determined to apply for a further £8000 for extending the plant, &c.

Alderman Higginbottom mentioned, at the meeting of the Manchester City Council last Wednesday, that tenders had been accepted for eight pairs of compound condensing engines for the sum of £12,440, for eight dynamo machines, for £7381, and for five Lancashire boilers, for £5371.

The Electric Lighting Committee of the Middlesbrough Corporation are of opinion that it would be in the true interests of the borough to proceed forthwith with the laying down of an electric installation at a cost of not less than £25,000. From inquiries, they are convinced that they will have sufficient customers to pay for the installation, and eight-tenths of the prospective customers are tradesmen. The Town Council, however, are of a contrary opinion; for, upon the matter being considered by them last Tuesday, 26 of the members (against four) declared themselves in favour of a motion by Alderman Hugh Bell, expressing the desirability of making a beginning with electric lighting, but showing that they are not prepared to agree, without further information, to an expenditure of £25,000. Alderman Bell thinks an installation costing £10,000 or £15,000 would suffice to start with; and the Electric Lighting Committee are to report the smallest amount for which a suitable plant can be obtained.

The Committee of the Ipswich Corporation to whom was referred the consideration of the question of obtaining a Provisional Order for electric lighting for the borough, have recommended that no further steps be taken at present. The Committee consulted Professor Kennedy, whose smallest estimate of £28,000 (so the Deputy-Mayor, Mr. S. R. Anness says) "rather took away the breath" of the Committee. Besides this a further £5000 would have had to be spent to carry out entirely an installation. Another matter which weighed with the Committee was the fact that there are now 1500 to 1800 incandescent gas-lights in use by private consumers, who, being thoroughly satisfied with them, could not be expected to go to the expense of abandoning them for the electric light. The Committee hesitated to recommend the Council to adopt Professor Kennedy's scheme; and a strenuous endeavour was made at last Wednesday's meeting of the Council to have the matter referred back to them. This, however, failed; and the report was adopted.

A Water Famine in the Rhondda Valleys.—The *South Wales Daily News* reports a serious state of affairs in the Rhondda Valleys, in consequence of the diminished and inadequate supply of water furnished by the Ystrad and Pontypridd Water Companies; this being attributable to the dry weather. It was announced at the meeting of the District Council last Friday week, that the reservoirs in both valleys had no water in store; being, in fact, practically empty. With regard to the Ystrad Company, it was mentioned by Alderman Morgan (one of the Directors) that their storage in the district had been exhausted; that the streams which flowed into the reservoir were inadequate at the present time; and that the Company were using every available drop of water in the vicinity. To make matters worse, the district is said to be infested with typhoid fever and other epidemic diseases.

Denton Gas Supply.—The accounts of the Gas Department of the Denton Urban District Council for the year ending March 25 last show that, under the management of Mr. J. Chadwick Smith, the result of the working has, on the whole, not been unsatisfactory. The receipts amounted to £10,607; the expenditure, to £6691—leaving a balance of £3916. After meeting interest and sinking fund charges, there remained at the close of the financial year a sum of £361, being net profit. Acting upon Mr. Smith's advice, the Gas Committee have reduced the price 2d. per 1000 cubic feet; making the charges 2s. 4d. to 2s. 9d. according to consumption. With respect to manufacturing operations, the make of gas was at the rate of 10,893 cubic feet per ton of coal carbonized, as compared with 10,533 cubic feet in 1893-4; the quantity sold per ton being 500 cubic feet more. Less coal by 340 tons was used; and it cost less per ton. The gross profit was nearly 1d. more per 1000 cubic feet of gas sold than it was in the preceding year; and the unaccounted-for gas was brought down from 11·71 to 11·08 per cent.

SOUTHWARK AND VAUXHALL WATER COMPANY.

The Half-Yearly General Meeting of this Company was held last Tuesday, at the Company's Offices, Southwark Bridge Road, S.E.—Alderman Sir EDMUND KNIGHT in the chair.

The SECRETARY (Mr. Alfred Jelley) having read the notice calling the meeting, the report of the Directors was taken as read.

The CHAIRMAN first drew attention to the receipt of a communication from the London and South-Western Railway Company, asking for a donation to their Servants' Orphanage. He stated that the Railway Company were very large customers, and that in 1891, in response to a similar application, the proprietors granted the Institution a donation of £50. The Directors themselves could do nothing in the matter.

On the motion of Mr. HANKEY, a resolution was passed making a grant of £50.

The CHAIRMAN then moved the adoption of the report and accounts. They met, he said, that day under very peculiar circumstances; and he did not know that he had ever addressed them when matters were so critical in the interests of the Company. A very important inquiry was going on; and it was being conducted by people with such an animus against them, that he did not hesitate to say they would, if they could get their own way, entirely confiscate the property of the Company, and leave them little or nothing. The evidence given, and the Bill itself which had been promoted, showed the animus that had dictated these proceedings, and what was aimed at could be described as nothing more or less than confiscation. Fortunately, however, the inquiry was being made before a tribunal of honourable gentlemen; and he could only tell them that the Board felt almost consumed with anxiety lest, through a failing on their part, they should not put everything before that honourable body of gentlemen so that the Company's case might be fully represented. He knew that notice would be taken of everything he said that day; and he spoke under a feeling of the greatest responsibility and fear, lest anything should slip from him which might in any way be disadvantageous to the Company. Feeling this responsibility, and knowing that under the circumstances questions must be asked, he hoped that every one of his partners would regard the position as he did, and consider whether what he was saying might damage the Company, or whether, in eliciting a reply to any question, he (the Chairman) might be induced to give information, if he were pressed for it, which he might think should not be given. He felt that the Board would have the proprietors' support, as he was sure they had their sympathy, under the difficult circumstances in which they met that day. They would have noticed that their capital account was overdrawn by £36,294; but under their Act of 1891, they had power left still to issue £83,231 of 4 per cent. debenture stock. The time had arrived when they must issue this stock; and the proprietors would have an opportunity of applying for it when they received their notices. This would complete the whole of the issues of debenture stock authorized by Parliament up to 1891; and their Act of 1894 enabled them to consolidate all their various debenture stocks into one stock called "Debenture Stock A." He believed they would find this to be of very great advantage in dealing with that portion of their property; and he knew it would obviate many disadvantages which had been caused by there being so many issues. This additional stock would be issued; and before Michaelmas the consolidation of the different debenture stocks would be carried into effect. He would now deal with the accounts; and he would refer to them as they were under the extraordinary circumstances they had passed through, and as they would have been but for those extraordinary circumstances. In dealing with the revenue account, it would be noticed, under the head of maintenance, that the total expenses were £53,634, as against £42,340 for the corresponding period last year—or an increase of £11,294 under that head alone for the half year. The item of maintenance and repair of mains, pipes, &c., came to £20,764, against £9957 for the same period last year; so that there was an increase in this item of £10,807. This, however, did not represent the whole of the expense they had been put to in consequence of the unprecedented frost. It was the amount that had been paid up to the present time, but did not include what would have to be paid in the coming half year. The excess now shown was £10,800, while they said in their report that the expenditure would be £20,000 from this cause. The sum paid to the Thames Conservancy for the past half year was £2346, against £1656—or an increase of £690. That was in consequence of the additional payment which Parliament directed them to make to the Thames Conservancy under the Thames Conservancy Act of 1894. Then there was the usual increase in the rates and taxes. These various increases accounted for the difference which he had mentioned of £11,294 under the head of maintenance. The total amount expended under the head of management was £7361, against £7026—or an increase of £335. This arose from law and parliamentary expenses, which were £1256 this time, against £830 for the March half of last year. They would therefore see that their expenses of management in themselves had somewhat decreased. They might perhaps be surprised when he told them—and he did not think they appreciated the fact, although he would like them to do so—that during the last five years the law and parliamentary expenses which the Company had been put to, not for promoting their own Bills, but in defending the Company's interests and fighting their battles, had been no less than £8124. In addition to this, the expenses of obtaining their Bill of 1894 were run up enormously by the unfounded opposition of the London County Council; and they had to add to this sum of £8100 a considerable portion of the expense the Company were put to in promoting their own Bill. They could not therefore put their expenses on this account in the past five years at less than £10,000—or £2000 per annum. Considering that there were eight London Water Companies, they might imagine what the total expenditure represented; and, further, there was to be taken into account the amount expended by the London County Council—the ratepayers' money—the Water Companies being the largest ratepayers in London. The expenses which the Water Companies themselves had been put to would thus amount to £80,000; and they might put in what amount they pleased for the London County Council. He hoped they would not forget these figures, which he had been glad to have had an opportunity of laying before them; and they would also see that they had had people to fight with who did not spend their own money, but that of the ratepayers, in making these attacks upon them. The amount available to transfer to the dividend and interest account was £49,419, against £58,663 in the corresponding period last year; so that they had £9244 less now than they had a year ago. He had shown them, however, that for extraordinary purposes beyond their control they had spent on maintenance £11,294 more; and deducting the £9244 from the £11,294, they would find that there was a surplus of £2050, which was actually more profit made by their concern in the past half year than in the same period of the preceding year. They were therefore really more prosperous than they were a year ago, as regarded earning profits. Looking at the other side of the account, he would show them something indicating the excellent way in which their affairs were managed. They had always £5000 put aside to meet losses; and this year they had a surplus from that amount of £1216, against £980 last year. This showed that their losses were less, and that their collections were better looked after than they used to be. He could remember the time when £8000 and £10,000 was put aside for this purpose; but now they only set aside £5000, and saved £1200 out of it. The water-rents accrued to the date of the account amounted to £113,377, against £111,345—or an increase of £2032. He had also shown them that, but for the extraordinary circumstances of the past half year, they would have had an increased profit of £2050. It was important to give them these figures, because there were those who would quote them with the view of showing what a depreciated concern the Company possessed. He had therefore thought it his duty to point out to them that, although Nature had inflicted a loss upon them, the Company itself was strong, vigorous, prosperous, and progressive. The £49,419 which they carried to dividend and interest account as profit transferred, added to the other items shown in the account, gave them £55,800 as profit, or money available to pay their interest and dividends. This £55,800 was against £62,941 at the corresponding period last year, or a difference of £7141—that was to say, they had less money to divide by £7141 than they had a year ago—but they must bear in mind that they had paid £11,294 for extraordinary circumstances, by a visitation of Nature not known for a hundred years. Deducting the £7141 from the £11,294, left £4153, by which sum they would have been better off than they were a year ago, had it not been for these extraordinary circumstances. Their debenture interest amounted to £19,467, against £17,702 last year; and deducting that from the total figure of £55,800, the amount left available for dividend was £36,333. He called their attention to that figure because in their report the Directors stated that the £20,000 extraordinary expenses they had been put to represented more than one moiety of their half-year's earnings; and he wanted to show how that statement was substantiated. Deducting from this £36,333 the dividend on their preference stock, £24,103 was left available; and if they paid a dividend of 4 per cent., the amount required would be £20,588—leaving £3515 to carry forward. He was sure they would agree with him that the proper thing was to meet this extraordinary state of circumstances, and pay this money, so as not to have a mill-stone hanging round their neck—to pay it at once and write it off, so that they could revert after this year to their old dividend, or possibly more, and show at once that they had only a falling off in the dividend owing to circumstances beyond their control. That was the policy the Board advised them to adopt. Not only could they, but for these extraordinary circumstances, have paid a dividend of 6 per cent., but they could have increased it to 6½ per cent., because £3515 was more than the additional amount required for this purpose. A dividend of 1 per cent. was represented by £5000; so that, if they had paid 6½ per cent., they would have had about £1000 over, had it not been for the exceptional circumstances to which he had had to call attention. He dwelt on these figures to show that they were a vigorous and prosperous Company, and that they had a very valuable undertaking. Their revenue had increased by £2032, and they were better off as regarded paying their dividend by £4100; and these were signs of prosperity which were indisputable. He had, perhaps, laboured matters a little; but he had felt it most important, in face of the present critical position and critical times, to show indisputably that, although they had less dividend, it was not a sign of want of prosperity, as they were really more prosperous than ever, and were only suffering from circumstances entirely beyond their control. Their well at Streatham was now at work; and they were pumping from it fully as much water as they had expected. They had not the least doubt that they would have a permanent source of supply there equal to 3 million gallons a day; and the figures they placed before Lord Balfour's Commission as regarded their sources of supply, were quite borne out now by facts. They were steadily and energetically proceeding to carry out their system of obtaining water from wells and other sources which they were legally entitled to draw upon, so that the Company might be in a position of prosperity, and that it might not be said of them that they depended on the Thames. The question of storage was dealt with by Lord Balfour's Commission; and all the Companies—but their Company especially—had honestly and steadily endeavoured to act upon the recommendations of that Committee. They considered it a valuable report—a report obtained on the best evidence; and they had set their shoulders to the wheel, determined to carry out what was recommended by Lord Balfour and his Commission. They had one of their large reservoirs at Hampton close upon completion, which would give them storage capacity for 90 million gallons of water; and they had a contract signed last year for another reservoir, which would give them further storage capacity of 300 million gallons. They also had other reservoirs which they were to complete by their Act of 1894. They were putting themselves quite in the way of meeting the requirements of that Commission, because they found they were proper, and were not only in their Act of 1894, obtained from Parliament, but obtained with an extraordinary addition—a clause being introduced to the effect that these reservoirs were to be proceeded with without loss of time. They had done so energetically; and they were in the position he had mentioned. A notion had got abroad that that Commission recommended Staines for these storage reservoirs. It was true that a plan was put before the Commission showing that reservoirs could be constructed at Staines, and

the Royal Commission approved that plan; but they did not say that Staines was the only place where such reservoirs could be built. They intimated that, if there were other places as suitable for them, it would be just as well; and that, if the work could be done cheaper elsewhere, it would be better still. They complied with the views of the Royal Commission. They took the water a short distance above their intake, from a reach of the river where Dr. Frankland and other experts said that the water was of the very best quality. Perhaps this figure would astonish them; but if they had gone to Staines, they would have had to pay £140,000 for a conduit before they could have had a gallon of water stored. He might also say that previous to signing the contract for these large storage reservoirs, they were able to obtain some neighbouring land enabling them to be constructed on a far more economical principle; and they would save a large sum in this way, as compared with what they had thought would be necessary when they went before Parliament. They had proceeded with this policy with determination, and against the most vigilant opposition. The saving they had made, compared with what they would have spent in going higher up the river, represented between £100,000 and £200,000. The proposed transference of the undertakings of the several Metropolitan Water Companies was dealt with in clause 4 of their report; but he could not say very much on that matter now, as it was *sub judice*. He had told them what the Board were doing, and their anxiety with respect to it. He did not know what they would have to do; and no one could tell at present. By cross-examination of witnesses, he thought they were pretty sure of the confiscatory nature of these measures. They would proceed as they had done hitherto, with the proprietors' support. It would be a very heavy expense to them, and one to which they ought not to be put. There should be some means by which, if the defendant gained, as the Companies had done, all along the line, the other side should be made to pay. If they could do this, he did not believe that the London County Council would be so ready to squander the ratepayers' money. As regarded the popular cry which had been raised against the Water Companies on account of the inconvenience suffered through the frost, it was really created by a very small section of the public; and many of this section in their own district were the very people from whom they had experienced the greatest difficulty in getting their rates. The error which existed in the public mind on this question of damage to the mains by frost was one which it would take volumes almost to explain away. All the Companies in London were very much in the same position; but the inconvenience had been felt in the same way in the provinces. At Birmingham, for instance, the mains were still out of order; and there the water supply was under the Corporation. They had been in a far worse position than any part of London. The percentage of broken mains in their district was exceedingly small, excessive as had been the cost of repairs. They had 1800 miles of mains; and the percentage of bursts had not been very great. The people to whom he had referred complained about the want of water; but they had not been without water. The Company fixed stand-pipes for them; and when the mains froze they sent round water-carts and supplied them in that way, which they were not bound to do. People who complained of the freezing of the mains said that, if they were laid at a sufficient depth, this would not happen. They might, however, be astonished to hear that mains laid between three and four feet below the surface had frozen; whereas some laid only one foot below the surface had not frozen at all. The nature of the soil, the temperature outside, and the temperature of the Thames when the water entered their mains—all these things had to be thought of, and must be thoroughly thrashed out, if they wished to arrive at a satisfactory conclusion on the point. As economists, they would not, of course, legislate for a state of things which occurred once in a hundred years, but for what happened every year. When they built a house, they did not build it strong enough to resist an earthquake; but very likely if houses fell down in consequence of an earthquake, there would be some people who would say: "How foolish it was not to have provided for such a contingency!" In times gone by, they did not know as much as they now did in connection with the laying of their pipes. He did not, however, think that Parliament would require them to lay their mains at a depth where no frost could reach them; but if Parliament did, the general public would have to pay for the great cost which would thus be incurred. There also seemed to be a wrong idea abroad as to the quantity of water taken being the quantity which should be paid for. Parliament had put on the Company conditions that they should supply certain water, at a certain pressure, at certain places. They had to procure the water, purify it, pump it, and convey it through their mains. All this necessitated a large expenditure of capital; and it was for this enormous amount of capital that the public must pay. What difference could it make to a water company when their mains were laid whether a man took one gallon or ten gallons? If, too, a fire occurred, the customer had the Company's water for nothing to extinguish it. This was also by authority of Parliament; but Parliament had said that the Companies should not be called on to do what was impossible. These were facts which could be easily understood, if men would only sit down and inquire into the position carefully; but it did not suit some persons to take this course, and they endeavoured to created a hubbub. The Directors had appointed Mr. Stuart-Wortley, M.P., to a seat at their Board. He (the Chairman) had told them all along that, in making this appointment, they would only have regard to the interests of the Company; and these, they felt, required strength in parliamentary quarters. He thought they were much indebted to Mr. Wortley for accepting their invitation.

Mr. C. M. VIALLS seconded the motion.

Mr. JEFFERIES said he thought that the extraordinary expenditure on their mains which had been rendered necessary by the exceptional frost might have been spread over a series of years. He was convinced that, if the water supply had been in the hands of the London County Council, people would have suffered very much more than they had done in the hands of the Companies. He was interested in other water companies; and he could speak from personal knowledge of the painstaking way in which the officers had endeavoured to relieve the inconvenience which had been caused. Some time ago, he was on the County Council; and he was convinced, from what his own experience had taught him, that the water supply could be better managed in the hands of the Companies than in those of the County Council.

The CHAIRMAN briefly replied, and the motion was adopted.

A resolution was afterwards passed declaring the dividends.

A vote of thanks to the Chairman, Directors, and staff was also passed, on the motion of Mr. JEFFERIES.

The CHAIRMAN acknowledged the vote; and said that, if they had spread over a series of years the exceptional expense to which they had been put, the proceeding would have been quoted as an evidence of weakness on the part of the Company.

The meeting then separated.

GRAND JUNCTION WATER-WORKS COMPANY.

The Ordinary Half-Yearly General Assembly of this Company was held at the Office, South Molton Street, W., on Wednesday last—Mr. F. TENDRON in the chair.

The SECRETARY (Mr. J. Goodwin) having read the notice convening the meeting, and some formal business having been disposed of,

The CHAIRMAN said that a very interesting report had been published by the Royal Botanic Society—their quarterly record of the frost; and he found from this that on the 7th of February last the frost in the air had reached its maximum. It was then only 7½° Fahr.; but a further period of about six days elapsed before that cold made itself felt at its greatest intensity at one foot below the surface of the ground. It had then fallen from about freezing-point to 28½° Fahr.; and it only reverted to 32° about six days afterwards. This was very interesting to the proprietors, as showing how exceptional the frost was in its long duration, the time it took to penetrate the soil, and how slowly the thaw, when it set in, enabled the Directors to deal with it. At 2 feet below the surface, the frost never penetrated—34° being the lowest temperature found; but though this was the case in the experience of the Royal Botanic Society, they were told that much depended upon the nature of the soil—some soils resisting frost much better than others, and especially where there happened to be a covering of grass. He had no doubt many of those present suffered as householders during the frost; and now they had also to suffer as shareholders in their dividend. The frost was a most expensive business to the Company. Bad as the money loss was, however, it really was nothing compared with the fearful inconvenience suffered by their customers, especially in the country districts; and if the Board felt that blame was attachable to themselves, they would not be without reproach. But the frost was unprecedented. No experience that had gone before enabled the Directors to foresee that such a calamity would befall their consumers. In London itself, they hardly had a main frozen. The frost attacked the connection-pipe; but this pipe was not the property of the Company, who had nothing to do with it. It belonged to the holder or the owner of the house; and it was through this misunderstanding that so much blame had been cast on the Companies. Wherever the householder's pipe froze, they did what they could to relieve the inconvenience by erecting stand-pipes, and by moving them in various directions to accommodate people with as little delay as possible. Their Engineer (Mr. A. Fraser, M.Inst.C.E.) was indefatigable; and their men worked Sundays and week days, and he did not know for how many hours out of the twenty-four. In the country districts, they were not quite so free from blame, or quite so free from having contributed to the misfortune; for about 5 per cent. of their mains froze. When he said "mains," they were often called service-pipes—4, 5, 6, or 7 inches in diameter; and they had brought this calamity on themselves by their good nature. They could have often refused to lay these service-pipes in the new districts, for they were not compelled to do it. They, however, laid them, in order that people should not suffer from want of water. They knew they would not get a return upon the expenditure they had incurred; but they never liked to have a house in their district which was not supplied. The Engineer put these pipes at a depth of 18 inches, which was considered ample in former days; and from what he (the Chairman) had told them of their experience at 12 inches in depth, it was natural for it to be thought that a depth of 18 inches would be sufficient. But highway authorities had interfered with the soil above these pipes, while in other cases the pipes had to be carried over bridges, where they could not get the requisite depth of soil; and certainly in some of the country districts the unfortunate people had a terrible time. There were innumerable letters written to them; but had it not been for the unfairness of some of the newspapers, he did not think there would have been anything like ill-feeling towards the Company. One paper attacked them in every possible way, and said that they only cared for the interests of their shareholders, and not in the least for those of the consumers. He would, however, give the proprietors a palpable proof to the contrary. Within the last fifteen years the Company had spent £446,000 on capital account; and out of this no less than £236,000 had been expended on unremunerative works—that was to say, for intakes, storage reservoirs, additional filter-beds, and works of all kinds that tended to ensure the regularity, fulness, and purity of the supply. The water was, on the whole, doubly filtered; and they had only to look at the returns of the Official Water Examiner, and to the still more important returns of their Chemists, who examined the water every day, to see what wonderfully pure water they were supplying to London. They had also been attacked on another point by people, who said: "Look at these Companies; they are actually going to claim their rates for the period during which they never supplied any water. Out of the thirteen weeks, people were deprived of water for six or seven weeks; and these monsters of iniquity are actually going to make them pay for the whole thirteen weeks!" The shareholders and the public would be astonished, he believed, when he told them that the average rental throughout the country districts for a full supply of water for all washing and cleansing purposes—including a bath—and for all culinary and even garden purposes, was under 1d. a day. So far as the Company was concerned, he knew that the amount of expense they were put to in connection with the frost, and for which they had had bills delivered, were about £6000. Their Engineer developed a wonderful capacity of expansion in figures; and at each Board day the cost of the frost became more and more, until at last, about the time of the

audit, it had risen from £5000 or £6000 to £12,000. They did not consider it right that the whole of such an exceptional charge should be debited against one half year. They knew that the only effect of charging it all against one half year would be to greatly depreciate the value of their stock. It would also have caused an immense amount of uneasiness; and it would not have been to the benefit of anyone, excepting those who had the good fortune to buy at the low price to which their stock would have been sent. They thought that the proper course was to spread the expenditure over the whole year. (A SHAREHOLDER: Quite right.) This policy was fully explained to Mr. Stoneham, the Government Auditor, and to the Shareholders' Auditors; and it was a great satisfaction to the Board to know that the policy they advocated had the full support of the Government Auditor and of Mr. Best. It was perfectly certain that they would have been most blameworthy if they had suppressed a fact of that kind from the Auditors or the shareholders. There was the fullest intention on the part of the Board that he should explain the whole position at that meeting; and he trusted that he had done so, as far as the expenditure was concerned, to their satisfaction. After having shown them that they spent £236,000 to ensure the regularity and quality of their supply, was it likely, if they had foreseen a difficulty from the frost, that they would have for one moment hesitated, on the money ground, about putting the mains to a greater depth? It was never foreseen that such a calamity would befall them. But it was now incumbent on them, of course, to take steps to prevent London from suffering again—even if they had a frost of such long and continued duration; and instructions had been given to the Company's Engineers to lower the mains as opportunities occurred. It was, however, of no use for them to lower the mains in the country districts unless the consumers would consent to lower their communication-pipes, or unless the urban councils acting on behalf of the consumers or ratepayers consented to bear the expenditure that was necessary. The Company did a great deal for the public, and had done so, because they thought that in so acting they best served the interests of the shareholders. That was the true policy; but he did not see any reason why they should act as a philanthropic body, and do work for householders which the latter were bound to do for themselves. No municipal town fared better than London in the recent frost. He thought, indeed, that he should be borne out if he were to say that the municipal towns suffered much more than London; and he did not believe that the municipalities treated their customers with more consideration than the latter received in London throughout the frost. With respect to the Bills before the Select Committee, they naturally had taken much interest in any paragraphs that had appeared in the newspapers on the subject. On the whole, he thought they might congratulate themselves that they had a Select Committee composed of men of marked uprightness and ability; and so far as the evidence had gone at present on the Southwark and Lambeth Bills, he did not think there was much chance of the unjust instructions to the Arbitrator passing that Committee. He would not deal with the various points raised, with the single exception of that of the adequacy of the supply, and of the possibility of the Companies meeting the expansion and enlargement of Greater London. He would touch on those points, because he would thus have an opportunity of putting true figures on record against those which had been submitted to the Committee. It was stated that the cost of the storage reservoirs at Hampton would be on one estimate £15,000,000, and on another £21,000,000. Now, they knew, as far as it was possible to estimate the cost of works—and they could not have a better estimate than when contractors of the high position of Messrs. Aird and Son said they were willing to do the work for that amount—that the actual outlay would be under £6,000,000; and instead of that amount having to be spent at once or within a few years, the outlay could be spread over 20, 30, or 40 years, or according to actual requirements. He did not think the London County Council could get over this important fact—he had stated it before, and he stated it again, so that if he were under an error he could be contradicted—that, while the Engineer of the London County Council estimated the requirements of Greater London in 1941 at 35 gallons per head per day for a population of 12 millions, drainage was only provided for 7 millions at that date; and certainly provision must be made for dealing with the water which people drank or used, or poured down the sewers. It seemed as if the Engineer of the London County Council had one opinion with respect to water requirements, and a totally different opinion as to what the sewage requirements would be in 1941. Since they last met and had had the frost, they had thought, from their experience, that it would never do for them to go on the market and issue 7 per cent. shares; and they must be contented with a smaller amount of money. They therefore decided that they would issue the small amount of debenture stock that they had to put out. They only had power to issue £15,000; and, after due consideration, they put the reserve price at 132. At that reasonable figure, they only had two tenders. One was from a shareholder, who said he would take £100 of the stock at £134 5s., or £200 of it at £133 15s. The other tender they received was for the whole £15,000; and they would have been rather in a fix if no one had applied for the £15,000. They would have been very pleased indeed if they could have obliged the shareholder who tendered; but it would never have done, for the sake of good-naturedly obliging one shareholder, to jeopardize the issue of the whole £15,000. They therefore gave the whole of this stock to the applicant for it at 133. He thought he had now dealt with all the matters he had to bring before them, excepting the question of filling up the vacancy on the Board; and he would ask them to be good enough to continue to leave that matter in the hands of the Directors. They had little doubt that the proprietors would unanimously elect the gentleman recommended by the Board, and that he would bring an accession of strength to the Board and also to the Water Companies in Parliament. He then moved—"That the report of the Directors and the statement of accounts be approved and confirmed, and that the recommendations contained therein be adopted."

Mr. FRANCIS TAGART seconded the motion.

Dr. LEESON urged the advisability of the Chairman's speech being circulated, in a modified form, among their customers, as many of the facts brought out by him were new. Great inconvenience had certainly been caused to the consumers by the frost; but, as the Chairman had said, this had been chiefly owing to the fact that the pipes in their own houses were not placed at a sufficient depth. He knew that a good deal of irritation was caused in his own district, where, however, Mr. Fraser's letter had a very soothing effect. He was sure they were all greatly indebted to their Engineer for his labours. He considered that the scheme which Mr. Fraser and Mr. Hunter brought forward had been almost the saving of the Company. Since their last meeting, a good deal of work had been done in connection with recent science on water questions, and Professor Ray Lankester had been giving some able lectures at the Royal Institution, and had brought out a fact which he thought should be known by all the shareholders—viz., that river water was more healthy and better to drink than the lake waters which the London County Council were so anxious to supply, or than the spring waters which many people were so desirous of having. He felt that the past half year had been perhaps the most anxious one the Company had ever passed through; and he was sure the Directors had the sympathy of the shareholders for their arduous labours and the disagreeable duties which they had discharged so wisely.

Mr. R. A. M'LEAN stated that, as reference had been made to his certificate to the accounts, he might briefly state the grounds of it. The unquestioned facts were that the recent frost burst some of the Company's mains, which had had to be removed and replaced by new ones; that the consequent loss to the Company, on the authority of their own Chief Engineer, was upwards of £12,000; and that the whole of that loss was sustained during the half year ended the 31st of March last. On these facts he submitted that the loss should have been shown in the accounts for the half year in which it occurred. Only half of it was included. No reference was made to the other half, nor to the consequent liability, then resting upon the Company, for the other £6000. The omission of any reference in the accounts to that liability, or to the total loss, constituted an error which it was the duty of the Auditors to correct. As the amount in question was sufficient to affect the dividend, an opportunity was afforded to any person interested to move the Court to restrain payment to that extent. If the Directors intended to spread the loss over more than one half year, the amount of the loss should nevertheless have been stated, and the intention to spread it. Without this, the shareholders were left in ignorance of the loss, and had no means of judging of any intention to spread it. The fact that the old mains were replaced by new ones did not justify the charging to capital of any part of the expense, because the old ones stood already in the capital account at their cost price new; and nothing had been written off for depreciation. He felt that in this matter the apparent weight of evidence was against the view he had taken—that was to say, that two Auditors, including the Government Auditor, seemed to take a different view. He was very loth to make any personal references; but he could not forget that some years ago the same two Auditors certified the Company's accounts to be correct, and that it was then his (the speaker's) duty to prove them to be wrong.

After a few remarks from Mr. LOMAS,

Mr. A. LUCAS said he had attended the meeting to thank the Directors, both as a shareholder and as a consumer, for the very extraordinary efforts they made under extraordinary circumstances. He had noted in the accounts Mr. M'Lean's objection, which he did not think worthy of serious consideration; but when Mr. M'Lean had taken the trouble to strain this point, he (the speaker) felt that he must say a few words out of loyalty to the Board. He understood that Mr. M'Lean had objected to the fact that an estimate by Mr. Fraser had not been placed in the accounts. Let them, however, look the matter plainly in the face. Certain bills had come in for expenses in connection with the frost; and the Directors had paid them. He believed that, in their private capacity, the shareholders would have done the same thing. They would have met their liabilities, and not have put down in their accounts an estimate which might be more or less wrong. Looking at the whole amount as a loss, would they, in their business capacity, have written off the whole loss at once? (No, no.) He maintained that they would not, but that they would have written off a much smaller percentage than the Board had done. He regarded the action of Mr. M'Lean as most ill-advised in face of the present difficulties.

Mr. J. BEST thanked the Directors for their great attention to the affairs of the Company in the past half year. The Chairman had shown them the condition in which the undertaking was at the present time, notwithstanding all that had passed. He had been greatly surprised at the objection which Mr. M'Lean had raised to the accounts. They could easily tide over the losses they had sustained; and in another half year they would probably be as well off as they were before. Instead of signing the accounts as he might have done, Mr. M'Lean had put in a foot-note conveying that there was something wrong in the action of the Board, and something detrimental to the interests of the Company.

Mr. WRIGHT said he understood Mr. M'Lean to say that he received no notice from the Board that it was their intention to spread the loss over the whole year, and that the loss was kept somewhat in the dark. He therefore did not think Mr. M'Lean had done wrong in bringing the matter before the shareholders; but he did not agree with that gentleman that the loss should all come out of one half year.

The CHAIRMAN, in reply, said he would read a letter which had been written to Mr. M'Lean on behalf of the Board, and also one which was subsequently written by Mr. Stoneham. He thought it exceedingly important that Mr. Stoneham's action should be clearly understood. He did not deprecate for a moment what had been written on the face of the accounts, which really only anticipated what he should have stated at the meeting. In their report, the Board said "the work of renewing and replacing injured mains is still going on; but the Directors are happy to say that the whole of the Company's district is in full possession of the normal supply of water." It was exceedingly difficult to know what amount was to be carried forward. Mr. Fraser's estimates constantly varied. There was no doubt that the Engineer spoke perfectly truthfully to Mr. M'Lean as well as to the Board; but, on information of this kind, and with figures constantly fluctuating, the Directors thought it wise only to deal with figures as they knew them. The position, however, was explained to Mr. M'Lean, to whom the following letter, dated the 23rd ult., was addressed by the Secretary: "In reply to your letter of the 18th inst.,

I am desired to say that the further expenditure in connection with the frost will be referred to at the general meeting. With regard to the £6500 carried forward to meet empty houses, &c., it is not considered expedient to vary the amount." He (the Chairman) did not know that a Board had to go into the whole question of policy with the Auditor, and make him judge of their policy as well as of the figures. It was not as if they had no Government Auditor. They were much indebted to Mr. Best, who had acted as a shareholders' Auditor. But they did not want to have another Government Auditor. He would now read Mr. Stoneham's letter, because he thought that Mr. M'Lean's action was an affront to the Government Auditor. Under date the 25th ult., Mr. Stoneham wrote the following letter to the Secretary: "I thank you for your note containing a copy of Mr. M'Lean's certificate. I need only say that, when I certified the accounts of the Grand Junction Company, I was fully aware that the whole of the liability the Company had incurred in consequence of the frost had not been included in the accounts. My view was—and I see no ground for thinking otherwise now—that expenditure of so exceptional nature as that under consideration might fairly and properly be distributed over the accounts for two half years. It was, of course, understood that the Chairman would state the facts to the shareholders." Continuing, the Chairman said, as far as the Board were concerned, he did not mind the attack which had been made on them—it enlivened the meeting; but they could not have the discussion carried any further that day.

The resolution was then put in the usual way, and declared carried unanimously.

The CHAIRMAN afterwards proposed the payment of a dividend for the half year at the rate of 7 per cent. per annum on the ordinary share capital and on the "C" and "D" shares.

Mr. TAGART seconded the motion, which was carried unanimously.

On the motion of the Right Hon. Lord KNUTSFORD, seconded by Mr. J. BEST, the retiring Directors (Messrs. C. Horsley, F. Tagart, F. Tendron, and N. Whiting), were re-elected, as was also the retiring Auditor (Mr. J. Best), on the motion of Dr. LEESON.

The CHAIRMAN then proposed a vote of thanks to the Engineer, Secretary, and staff, for their devoted services during the most trying time that the Company had passed through.

Mr. M'LEAN cordially seconded the motion; remarking that he saw a great deal of the work of the staff, for whom he entertained considerable regard.

The motion was carried unanimously.

Mr. LUCAS afterwards proposed the confirmation of the resolution passed at the last half-yearly meeting, increasing the allowance to the Directors to £2500 a year. He noticed by the Directors' report that they had decided to forego this increase for the present. Personally, he thought it rather hard on the Board that, because they had had increased work and anxiety, they should receive practically less payment; but, at the same time, the decision of the Directors showed the very high-minded spirit which pervaded them.

Dr. LEESON seconded the motion, which was carried unanimously.

A cordial vote of thanks to the Chairman and Directors was also passed.

The CHAIRMAN, in reply, thanked them for their generous support in a very trying time. He said they needed to be well backed up by the shareholders, as did all the Water Companies, in the very heavy contest on which they were now embarked. In reply to Mr. C. W. Lee, he added that, if the Select Committee passed any Bills to sanction the buying of some of the undertakings of the Water Companies, they must pass Bills for buying the whole of them. That view had been laid down by Parliament in former days.

The proceedings then terminated.

SHEFFIELD CORPORATION WATER SUPPLY.

Annual Report and Accounts.

The annual report of the Manager of the Sheffield Corporation Water Department (Mr. W. Terrey) has been issued. It shows, in the first place, that the capital expended on March 25, 1894, amounted to £2,193,903, and that during the past year an additional £11,533 has been spent—making a total of £2,205,436. As to the revenue account, the income derived from water-rates for domestic and trade purposes during the year amounts to £100,779, as against £97,782 in the previous year; showing an increase of £1123 from water supplied for domestic purposes, and £1874 from that for trade purposes by meter—a total increase of £2997. The receipts for meter-rents, house, land, and mill-rents, and plumbing work amount to £5133; making the total income from all sources £105,912—an increase of £3148, or 3·06 per cent. over the amount for the previous year. The expenses of maintenance and management came to £21,768; showing an increase of £1833, as compared with last year. The net revenue is therefore £84,144, on which are the following charges: Annuities, £56,305; and interest on debentures, Corporation stock, &c., £19,797. Deducting these sums, there is a net profit on the year's working of £8041, as against £7973 in the preceding year. The seventh annual instalment set aside out of revenue for the redemption of annuities and extinction of the loan and indebtedness amounts to £6243; so that there is a surplus for the year of £1798. The accumulated deficiency of revenue amounted in 1891 to £7538; and since that date the surplus resulting each year has gradually increased to a total of £7587 on March 25 last. The deficiency is therefore wiped off; and the accounts now show a net surplus of £49, after discharging all liabilities against the undertaking, including the provision for sinking fund. The appropriations to the sinking fund during the seven years ended Dec. 31, 1894, with earnings thereon, amount to £44,113; and the liability from Jan. 1 to March 25 last is £1417—making the total amount provided from revenue account £45,530. Concerning the effects of the late frost on the distributing-pipes, Mr. Terrey says these were only partially disclosed prior to March 25 last; and even now are not fully ascertained. The accounts therefore bear only a comparatively small portion of the cost incurred in connection therewith. Reports began to reach the office from householders deprived of water about the end of January; and immediately a special staff of men were employed to afford temporary supplies from the nearest hydrant or plug available, and to convey water by means of water-carts into those districts otherwise unable to obtain a supply. The maximum number of water-carts employed was 23; and the number of men engaged upon this duty was 86. It is estimated that about 20,000 houses were deprived of their ordinary supply by the action of the frost, and received a daily supply of water from the stand-pipes or water-carts. In addition to the ordinary staff and the men engaged in distributing water, temporary men were first employed on Feb. 22 in renewing fractured pipes caused or disclosed by the frost; and although considerable difficulty was experienced in obtaining the services of competent pipelayers, the number of men was increased, as circumstances required, to a maximum of 535 on May 11, at which date the resources of the department were taxed to their utmost limit. The difficulty in maintaining the supply reached its most acute stage during the week ending March 7. The number of streets or roads affected was 212; and the total metal service-pipes found to have been fractured was 8614. The cast-iron pipes repaired or re-laid amount to an aggregate length of 14¾ miles. Many thousands of lead communication-pipes burst between the mains and the houses, belonging to the owners of the property; but the department have no means of ascertaining the exact number. Of the 2892 meters now in use, 120 were damaged by the frost, and have been repaired at the cost of the consumers. The expense of affording temporary supplies and the special repairs in connection with the frost has been as follows: Temporary supplies, £696; and general repairs, £460. The net profit for the year is therefore reduced by £1156. The further expenditure incurred between March 25 and May 25 amounts to £7317, and, which, of course, is not included in the present accounts. The work of relaying and lowering pipes is still being carried on; and, even at the beginning of June, 170 additional men were employed remedying the defect caused by the frost. The expenditure on capital account to March 25 last includes £898 for new meters, for which the sanction of the Local Government Board has not yet been received. The number of houses served with water is 74,571; being an increase during the year of 1100. The number of water-closets supplied is 6430; and the number of baths, 3790. There are 2892 water-meters now in use, as against 2784 last year. The grand total of all supplies on March 25 was 95,896, against 93,789 in the previous year.

THE BARNSLEY CORPORATION WATER BILL.

An Agreement between Opposing Authorities.

The Consultation Sub-Committee of the Sheffield Corporation Water Committee have presented a copious report on the subject of the Barnsley Corporation Water Bill. Their opinion is that the attitude of the Committee on behalf of the Corporation should continue to be that of firm opposition to the Bill. They trust that the Committee still agree with them that the wants of Barnsley may be amply met without the injury which the Bill would entail upon the inhabitants of the Don Valley, and that they will still be able to satisfy Parliament that such is the case. The Sub-Committee consider it very important that the agreement which has been come to by Sheffield, Rotherham, and Doncaster should now be sealed by the respective Corporations, and thus become binding upon them; so that, in continuing the contest in Parliament, and also in regard to the Dewsbury Bill, the three Corporations may present themselves in complete accord and union, and as absolutely bound to carry out a scheme, the object of which is to benefit the Don Valley as a whole, and to utilize the water resources to the best advantage, by not only securing to Sheffield the future supply of water which will undoubtedly be needed, but by giving also to Rotherham and Doncaster (both of which towns have proved a very decided case of want of water) that share in the waters of the Upper Don which, in the opinion of the Sub-Committee, they are legitimately entitled to. The Sub-Committee believe these objects may be well secured without denial of due and proper supplies of water to Barnsley from proper sources. By the agreement into which Sheffield, Rotherham, and Doncaster are to enter, each Corporation are to do their utmost, at their own expense, to defeat the Bills promoted by Dewsbury, Heckmondwike, and Barnsley. If successful in their opposition, Sheffield is in 1896 to promote a Bill seeking for power to construct reservoirs, &c., in the valley of the Little Don, to enable them to carry out their engagements under the agreement. The quantity of water Sheffield shall deliver per day at Rotherham and Doncaster is set out, as well as the terms of payment by the Corporations taking the water.

At the meeting of the Sheffield City Council on Wednesday, Alderman Gainsford, referring to the above agreement, said he wished the Coropration had had it before them three months ago. They had never questioned the proposition that Barnsley needed water. He would be willing to go further, and admit that Barnsley, as a town near to Sheffield, in South Yorkshire, and with a certain community of interest with Sheffield, might fairly expect, and would, he believed, receive at the hands of the Council, or of the Water Committee, every consideration. On the other hand, Sheffield itself had only a water supply which would last (according to recent calculations) until the year 1917. If they supplied water to Rotherham and Doncaster, as the agreement proposed, they would be in the position of having to go to the Little Don for supplies in 1908. For his part, he thought neither side ought to endeavour to override the other. Sheffield did not want to prevent Barnsley having a fair supply of water, neither ought Barnsley to try to damage Sheffield and the other places in the Don Valley in the very unfair manner proposed by their Bill. What they intended was this: As was well known, the top waters of any stream were always the purest and best in every respect, and the cheapest and easiest to collect. Barnsley having already the use of the top waters of one stream at Ingbirchworth, was utilizing only a little more than one-half of the water available from that stream. Instead of using the remainder, or in any way showing consideration for the just needs of Sheffield, it was proposed to leave the inferior and more expensive parts of the Ingbirchworth stream, and to take the top and best waters

from another valley. This was not a fair scheme; and it was not one which they could accept.

A short statement regarding the Bill was made at Tuesday's meeting of the Barnsley Town Council, by Alderman Raley. He thought the Council and the inhabitants would be satisfied with the progress the Bill had made; but although they had overcome the opposition in the House of Lords, they had to face similar opposition in the Commons. The members, he believed, would agree with him that the course the Water Committee had pursued had been fully justified by the view which the House of Lords had taken of the matter. They were of opinion that, in going to the House of Commons, they had every prospect of ultimate success.

BRADFORD CORPORATION WATER DEPARTMENT.

Annual Financial Report.

In the course of his annual financial statement to the Bradford Town Council last Tuesday, Alderman John Hill, the Chairman of the Finance Committee, supplied some particulars as to the monetary affairs of the Water Committee. Their accounts, he said, were not so favourable this year as last; the excess of payments over the receipts leaving a deficiency of £2769. But at the end of 1894, there remained to the credit of the revenue account £12,136, from which it was proposed to make good the deficit, and so avoid any rate in aid. This deficiency of income had arisen chiefly from a few large concerns using less water than formerly, partly owing to bad trade—in fact, a strike at one of the dye-houses alone cost the Corporation £1000. The income for water had been: Domestic purposes, £56,094; supply through meter, £63,515; rents of property, £1099; consumers' service account, £1050; repairs of property, £497; testing water-fittings, £104; the Soke and Goit, £168; Brownroyd reservoir, £525; and old materials and grass, £48—a total of £123,101. The payments on water account had been as follows: Salaries and wages, £5173; rents, rates, and taxes, £8726; general repairs, £2683; filter-beds at Gilstead, £715; filter-beds at Thornton Moor, £430; Heaton pumping-station, £269; waste water prevention, £956; Soke and Goit, £67; Liversedge water supply, £461; coal, coke, and water-rents, £160; printing and stationery, £225; stamp duty, £279; law and parliamentary charges, £4420; water, £944; sundry disbursements, £1080; interest on loans, £78,402; sinking fund, £20,869—making a total of £125,870. If it had not been for the heavy law and parliamentary charges, the Committee would have had at least £1000 to the good this year. This certainly was a more satisfactory statement than he was at one time prepared for, considering the large outlay which was going on in the Nidd Valley, and the heavy law costs which the Corporation had been driven to incur by people wanting to take advantage of them.

The New Water-Works for Gloucester.—The water-works which the Gloucester Corporation are having constructed at Newent are progressing satisfactorily; and the Council have now agreed to accept the following tenders for pipes, &c.: From Messrs. Cochrane and Co., for cast-iron pipes, at a cost of £10,373; from the Glenfield Company, for valves, at £318; and from Messrs. Cruwys and Hobrough, for contract No. 4—a reservoir and pipe laying—at £6176.

Water-Works for Masham.—Last Thursday Mr. G. W. Wilcocks held an inquiry at Masham, respecting an application by the District Council to the Local Government Board for power to carry out a scheme of water supply. Mr. J. H. Calvert, Clerk to the Council, stated that it was their intention to bring water from the township of Healey, and *en route* the villages of Healey and Fearby would be supplied. These villages at the present time were practically without water; and Masham was very inadequately supplied. The cost of the works would be £3850.

The Affairs of the Oldham Corporation Water Department.—Replying to questions upon the subject, Mr. Lee imparted to the members of the Oldham Town Council, at their last meeting, some information respecting the cost of the Castleshaw water-works. He said that the total was £226,070, as against the estimates of £210,727. But to this must be added £12,066 for work done outside the parliamentary estimate, which made the difference between the estimated and the actual cost £3277. While there was this difference, it was only fair to say that there was a great saving in land, of which they had obtained some 100 acres more than they had contemplated. The Engineer's parliamentary expenses came to £1500; and the amount paid to him for the construction of the works, including a resident engineer, was £9336. With reference to the Committee's reserve fund, it was created some years ago by the increase of the water-rate; and it now amounted to £22,182. The fund had not been drawn upon.

Brighton Corporation Water Supply.—The accounts of the Water Committee of the Brighton Corporation for the year ending March 31 last show receipts amounting to £47,570, including £45,662 from water rates and charges, and £1816 from sundries. The chief items of expenditure were pumping and storage, £7032; distribution, £1654; rents, rates, and taxes, £4904; and management expenses, £3626—the total being £17,311, and the gross profits £30,259. From this, however, have to be deducted interest on borrowed capital, and charges on sinking fund, amounting together to £22,577, and leaving a balance of £7681. The Committee have resolved to transfer £7500 to the borough fund. In moving the confirmation of the proceedings of the Committee at the last meeting of the Town Council, Mr. Broadbridge pointed out that the profits of the department had been increased to £7681—a result which he attributed to the energy and ability of the Engineer (Mr. Johnston). They had, he said, been enabled to give to the rates £2000 more than before. There was a saving in almost every department of Mr. Johnston's administration; and it was significant also that this profit had been made with a declining revenue, for the receipts for the past year were something like £830 less than previously. Speaking of the waste of water in the borough, Mr. Broadbridge stated that in the preceding week 40,000 tons—equal to 10 million gallons—more water was supplied than in the corresponding week last year. The proceedings were confirmed.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Gas Institute meeting in Edinburgh has come and gone. Of the meeting itself, the work it did, and the value of its labours, you will be treating in other columns. I shall therefore only deal with what was outside that sphere. Mr. Mitchell, the President, was unreservedly congratulated upon his opening address and his management of the business; and he is now to be congratulated upon the successful termination of a period of unwonted activity, both in his own business and in that of the Institute. He will now enter upon a well-earned rest, which, it is to be hoped, will lead to the improvement of his health. It was gratifying to see him so well supported by the leading members of the North British Association, scarcely anyone of whom was absent. The reception and dance given by the Edinburgh and Leith Gas Commissioners on Tuesday night was well attended, and was thoroughly enjoyed by all. Bailie Kinloch Anderson was an efficient "Convener of the Works Committee" of the function, as he is of the Gas Commission. The smoking concert on Wednesday night was, in a sense, too successful; the number attending being in excess of the accommodation. Many were obliged, on account of the condition of the atmosphere, to make their stay in the place short; and they thereby missed a very fine entertainment of its class. To Mr. Masterton, the Assistant Manager in the Edinburgh works, I understand, the chief credit is due for the organizing of the entertainment. There was, on Wednesday afternoon, an enjoyable drive to the Forth Bridge, including a detour by the way to Gogar Park, where Mr. James M'Kelvie dispensed hospitality on a liberal scale. On the Thursday afternoon, Mr. James Milne held a garden party at his residence, Baberton House, which was well attended, and would have been more so had it not clashed with the closing session of the Institute—a circumstance that could not be avoided. The excursion to the Clyde and Loch Lomond on Friday, which brought the proceedings to a close, was attended by nearly 600 persons; and, the weather being fine, it was a great success. It may be mentioned that, while the presence of the Institute in the city was a subject of a good deal of interest to the citizens, the local press did little to assist the community in acquiring a knowledge of gas affairs. The reporting was both trifling in amount and wretched in quality. One newspaper missed Professor Lewes's lecture altogether, although it was the feature of the meeting. There was a general expression of regret at the news which leaked out towards the close of the meeting, that this was the last occasion on which Mr. Burfield would act as Secretary, in consequence of his having accepted an appointment at Tunbridge Wells.

The Perth Gas Commissioners were able, on Monday night, to reduce the price of gas by 3d. per 1000 cubic feet; making it now 3s. 6d. This, Mr. Wright, the Convener of the Works Committee, said they were able to do entirely on account of the manufacture of gas from oil. Their results by the Peebles process placed beyond dispute its value as an enricher of ordinary coal gas. In presenting the accounts for the year, Mr. Wright said they estimated that 89,250,000 cubic feet of gas would be sold; while they had actually sold 96,500,000 feet—an increase of 7,250,000 feet on the estimate. This increase had not been confined to one class of consumers. It was true that large consumers—those who burn over 100,000 cubic feet annually—had added 5,500,000 feet to their consumption; but the small consumers (and there were 4000 whose average consumption was less than 4000 cubic feet per annum) had taken 1,750,000 feet more. The revenue from gas sold had been £17,690, or an increase of £1376 on the previous year. Meter-rentals, although reduced one-third last year, had brought in £435, or £8 more than the estimate. Naphtha showed a reduction of £258 on the estimate, which was entirely caused by the lower market price of that article, and to having used a very large quantity of it in the manufacture of gas during the year. Tar, coke, and rents were just about what was expected; and the total amount of their income was £1080 above the estimate. On the expenditure side, coal and oil showed an increase of £358; this being almost entirely owing to the great coal strike. Wages were up £430; the laying of larger gas-mains and the alterations at the works being responsible for £296. Feu-duties and taxes showed a total increase of £169. In addition to the ordinary expenditure, two new items appeared—viz., £367 for the purchase of the royalty on the oil-gas patent, and £74 invested in gas-cooking stoves, which would bring in a revenue of fully 12½ per cent. The unaccounted-for gas amounted to 8·01 per cent., being only a mere fraction on the previous year; but when they considered the severe winter, the wonder was that it was not much larger—the average for the last five years having been 8·14 per cent. The illuminating power of the gas had also been equal to 27·87 candles; that for 1893-4 having been 27·57 candles. Coal and tar produced 9878 cubic feet of gas per ton of coal carbonized; and oil, 21,974 cubic feet per ton, giving gas equal to 98-candle power. The indebtedness of the Commission consisted of: Present value of gas annuities, at £191 per cent., £85,950; borrowed money, £14,000; and debts due, £1991—making a total of £101,941. The works were valued at £108,000; the sinking fund amounts to £1573; the depreciation fund stands at £1490; and there were other assets which brought out an apparent balance in favour of the Commission of £15,224. For the current year, nothing sensational was proposed. They expected to sell 2,000,000 cubic feet more gas, and to produce that, they estimated that 9500 tons of coal and 650 tons of oil would be consumed, costing £7141. The other ordinary items in the expenditure would be sufficient to keep the working plant up to its past high state of efficiency. The revenue side of the balance-sheet was framed on an expected sale of 98,500,000 cubic feet of gas—an increase, as previously stated, of 2,000,000 feet; and when it was mentioned that the increase for May, which was the first month of their financial year, had been nearly 600,000 feet, the estimate might fairly be expected to be exceeded. The secondary products were estimated to bring in a sum equal to last year's revenue—viz., £2623. The total estimated expenditure was

£20,020; and to get this, a gas-rate of 3s. 6d. per 1000 cubic feet of gas sold in Perth, and 3s. 11d. in Scone would be sufficient. It was therefore proposed to fix these rates. The reduction of 3d. per 1000 cubic feet was a saving of £1231 to the gas consumers of Perth, or a sum equal to 2¼d. per pound of taxes. The accounts were adopted, and Mr. Wright and his Committee were thanked for their services. Lord Provost Dewar remarked that the undertaking was so well managed that he supposed the works could be transferred to a new site without costing the citizens a single penny.

As to the removal of the works, a somewhat amusing incident arose. In Perth, there is one of the largest prison establishments in Scotland; and it was reported to the Gas Commission that the Secretary to the Prison Commission had written to the Gas Commission stating their apprehension that, if the gas-works were removed to the Sand Island, it would have a most prejudicial effect on the prison, and asking that they be informed of the steps proposed to be taken in order that they might consider as to protecting the Government property. The Clerk was instructed to reply explaining the present position of the matter; and pointing out that in any event the prison buildings were beyond the statutory 300 yards from the site which would be occupied, assuming the works were removed to the Sand Island. What a pity it would be to do anything which would impair the amenity of a prison.

It was reported to the Kirkintilloch Police Commission on Monday that the output of gas from the Corporation works during the past year amounted to 26,622,000 cubic feet, or an increase over the output in the preceding year of 839,800 cubic feet. The quantity of coal carbonized was 2939 tons, as against 2963 tons; the yield of gas per ton of coal having risen from 8700 to 9058 cubic feet. It is anticipated that a reduction in the price of gas will be made.

The Town Council of Rothesay have finally resolved to transport their gas-works to the new site at Broadcroft Mills, which they recently acquired; and on Monday they appointed Mr. Andrew Gillespie, of Glasgow, engineer for the construction of the new works, at a commission of 5 per cent., and gave him instructions to prepare plans and specifications. One or two of the members of the Council thought they should wait till the existing works were more exhausted; but Provost Milloy and others considered they were already quite inadequate. The Council, by 11 votes to 5, resolved to proceed. The Council completed their annual contracts this week. Messrs. J. Ross and Son, of Falkirk, are the purchasers of the tar and liquor. Of coal, 4300 tons were arranged for, at an average price of 12s. 11¼d. per ton, as compared with 13s. 7d. per ton last year. The saving on coal is estimated at £143; on lime, £20; and on freight, £18. There is expected to be a loss of over £95 upon the sale of residuals; and cartage is to cost them nearly £4 10s. more; so that the net saving upon last year's figures will be about £80. The Council have difficulty in disposing of waste lime. The farmers object to it, on the ground that it is in large lumps, and difficult to break. It has been resolved to break down the lumps in the gas-works; and an effort will then be made to induce farmers to take it. If not successful in that way, a place to deposit waste lime must be found.

The Kinross and Milcenathort Gaslight Company have paid a dividend at the rate of 6 per cent. for the year, and have continued the price of gas at 5s. per 1000 cubic feet. The Company have introduced an oil-gas installation.

The Dunoon Gaslight Company, Limited, has been reconstructed under the name of the Dunoon Gas Company, Limited; the word "light" being dropped, as I suppose it will be in all future new companies, seeing that gas is applied to many other purposes than lighting. The capital of the old Company was £10,000; and that of the new Company is £18,000, divided into 6000 shares of £3 each. The registered office is at the Gas-Works, Dunoon. The output of the Company is over 15 million cubic feet of gas per annum, so that the capital should be ample for a considerable extension of business.

The Edinburgh and District Water Trust have now obtained their Act for the extension of the water supply, and are setting about putting the powers contained in it in force. They have, however, some unexhausted powers under their previous Acts; and these they are taking advantage of. I do not think, though they are obliged to give a constant supply, that they have ever been able to do so. In the high-lying parts of the district, there are yet many places which are without water for several hours in the middle of the day. To remedy this, the Trust have laid a new 24-inch main from the service reservoir at Alnwickhill, about three miles from the city bounds, to Hope Park, about one mile within the city boundary, and a 16-inch main from there to the Iron Church, in the centre of the city. By this means, they have been enabled to increase the pressure half-way up the High Street, from 30 to 60 feet, with the result that apartments on the fifth and sixth flats there now get water all the day through. Some of the houses are ten stories in height; and the upper flats are still unsupplied. Further measures are to be taken in the way of improving the water supply; and on Thursday the Trust let to Messrs. J. Young and Sons, of Edinburgh, a contract for the erection of two new filters and a pure water tank of 5½ million gallons capacity, at the price of £23,394. Further main extensions, in the south-western district of Edinburgh, were also resolved upon, at a cost of £1128. The contracts for the works at the new source of supply at Talla, will be advertised soon.

New Joint-Stock Companies.—The Dunoon Gas Company, Limited, has been registered with a capital of £18,000, in 6000 shares of £3 each, to acquire and work the undertaking of the Dunoon Gaslight Company, Limited. The Maxim Gas Economizing Company, Limited, with a capital of £5000, in £1 shares, is to acquire "certain patents relating to an improved means of enriching coal gas."

The Stamford Town Council and the Water-Works.—Lord Burghley has addressed a communication to the Stamford Town Council dealing with the suggested purchase of the water-works for the borough. His Lordship states that he has conferred with his father, the Marquis of Exeter, on the matter; and that Lord Exeter is convinced as to the undesirability of negotiating for the purchase of the works at present. In consequence of this letter, the Health Committee have requested that a special meeting of the Corporation should be called to consider the question.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 15.

Sulphate of Ammonia.—The market has been somewhat irregular; but it closes with a decidedly firmer tone at £10 f.o.b. at the ports. On the one hand, re-sales of small parcels have been made at easy prices—no doubt with the object of depressing the market. On the other hand, makers have offered sparingly; and such parcels as they have tendered have been readily picked up at full prices. There are indications that actual requirements are considerable, and that orders are mostly in the hands of dealers. Hence it may be expected that determined efforts will be made to prevent prices further advancing. The forward position is unchanged; makers' attitude being that of standing aloof for the most part.

Nitrate of Soda is steady at 8s. 3d. per cwt. for good, and 8s. 4½d. for refined quality. It is reported that further progress is being made in the direction of combination by the raisers. Autumn shipments are firm; but there is not much activity.

LONDON, *June* 15.

Tar Products.—The feature of the week has been the continued firmness in pitch, at the advanced prices which have been given for forward delivery. Benzols show no improvement, but are the reverse; and prices which are offered by buyers have not led to much business during the week—sellers preferring to deal for prompt delivery, and buyers desiring to buy to the end of the year. Carbolic acid has been better inquired for; but 1s. 7½d. is its present value. Prices may be taken as follows: Tar, 18s. to 22s. Pitch, 34s. to 36s. 6d. Benzols, 90's, 11½d.; 50's, 11d. Solvent naphtha, 1s. Toluol, 1s. Crude, 30 per cent., naphtha, 4½d. Creosote, liquid, 1½d.; ordinary, 1d.; salts, 20s. Cresylic acid, white, 1s. 2d.; brown, 11d. Carbolic acid, 60's, 1s. 7½d. Anthracene, "A quality," 1s. 1d.; "B," 9½d. to 10½d.

Sulphate of Ammonia has slightly improved. Business has been freely done at £10 to £10 5s.; this being the current offer for July delivery, less 3½ per cent. Gas liquor is at present quoted at 7s. 6d. to 8s. 6d. per ton.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—The season's gas coal contracts are being gradually settled on the exceptionally low basis of prices which I indicated a couple of months back. With regard to the Manchester Corporation contract, to which I referred last week, a very significant statement has been made by the Chairman of the Gas Committee, which more than confirms what I have previously intimated as to the specially favourable conditions on which users of gas coal have been able to place their contracts. According to this statement, the Corporation have been able to make even a still larger saving on their contracts than they secured last year, when it amounted to £18,000. As the prices in 1894 were very little over the excessively low rates of the year before—not more than from 1d. to 3d. per ton—it is obvious that the present contracts must have been taken at even still lower figures than those of 1893. So low have the prices been, that the Corporation have considered it prudent to purchase 150,000 tons over and above their present year's requirements. Judging from the Lancashire collieries which have secured contracts (and I have been furnished with a list of nine, who have contracted for close upon 200,000 tons), the bulk of the supplies would appear to be the Wigan four-feet gas coals. In one instance it is stated that for this coal, well screened, nearly 7s. per ton at the pit has been obtained; but this is a very special figure, which represents about the average for Arley coal, while 6s. 6d. would be the full average for Wigan four-feet. As regards the general round coal trade, the position would seem to get, if anything, worse; some collieries not running more than two, and the average scarcely exceeds three days per week. House-fire qualities are necessarily just now only in the smallest possible request; but as reductions in price would do little or nothing to increase business, quotations remain nominally unchanged. It is, however, exceptional where more than 10s. per ton at the pit is being got for best Wigan Arley; 8s. 6d., for Pemberton four-feet and seconds Arley; and 7s. to 7s. 6d., for common house coals. Steam and forge qualities are a complete drug, and obtainable at almost any figure—5s. 6d. to 6s. per ton being taken for ordinary descriptions; whilst for shipment, 7s. 6d. to 7s. 9d., delivered at the ports, are about the average figures. Engine fuel tends rather to harden, owing to the limited production of slack. Advances of 3d. are being quoted; but except where prices were previously specially low, it is difficult to make any upward move. Common slack does not average more than 3s. to 3s. 6d. per ton at the pit mouth; with better qualities quoted at 4s. 6d. to 5s.

Northern Coal Trade.—There has been more animation in the northern coal trade of the last week or so; partly because the summer shipments are now in full swing, and also because some dread of labour difficulties is causing buyers in certain cases to secure larger stocks than they have had. Best Northumbrian steam coals are thus in demand, and the price has been very much stiffened; so that, whilst the quotation is generally from 8s. 9d. to 9s. per ton f.o.b., the latter price has had to be paid for several cargoes to ensure delivery. Steam small coals are a little more plentiful, and are quoted 3s. 6d. to 3s. 9d. per ton; the fuller working of the large coals necessarily ensuring a better supply of small. In regard to gas coals, the shipments are now much increased; and in the course of a fortnight or so the home consumption must also be expected to advance. There will thus soon be fuller work for the collieries, though two or three months of enlargement will be needed to give anything like general activity at the gas coal collieries. There are negotiations now in progress for two very large contracts; and it is expected that in each case there will be a saving to the gas companies of about 1s. a ton on the expiring contracts, though the exact details of price are not likely to be known for a few days. For odd cargoes of gas coals, the price varies from 6s. to 7s. per ton f.o.b. There is little or no alteration in manufacturing coal; and household coals are at about the lowest point in demand for the year, and are

weak in price at from 10s. to 11s. per ton f.o.b., with rather higher prices at the land-sale collieries. Smithy coal is in large inquiry, especially for export. In coke, the demand is larger; there being more furnaces in work in the north-west. The price is firm, though varying according to quality from 12s. 6d. per ton f.o.b. up to 14s. per ton. Gas coke is unaltered in price.

Scotch Coal Trade.—Dulness still prevails. The miners are only working three or four days a week; and still large bings are being formed at pitheads, and loaded waggons are accumulating in railway sidings. There is, as yet, no prospect of any improvement. The prices quoted are: Main, 5s. 9d. per ton f.o.b. Glasgow; ell, 6s. 9d. to 7s.; splint, 6s. 3d. to 6s. 6d.; and steam, 7s. 6d. to 7s. 9d. It may be said that purchasers are anxious to contract forward at present prices, but that coalowners are loth to enter into contracts. The shipments for the week amounted to 146,234 tons—an increase on the preceding week of 11,480 tons, but a decrease as compared with the corresponding week of last year of 15,082 tons. For the year to date, the total shipments have been 2,796,216 tons—a decrease upon the quantity in the same period of last year of 401,630 tons.

The Oil-Gas Question at Bradford.—The Bradford Corporation Gas Committee had under consideration last Friday the question of appointing an expert to inquire into the working of the oil-gas plant now being tested at their works. After discussion, it was decided to negotiate with Mr. Lewis T. Wright, of London; and if his terms were satisfactory, to engage him to inspect the apparatus, and report on the advantages and disadvantages of the process.

Salaries of Officials in the Stockport Gas Department.—The minutes presented by the Gas Committee at the meeting of the Stockport Town Council last Wednesday showed that they had further considered the resolution as to the increase of the salaries of three of their officials—Messrs. Meunier, Bedford, and Robinson—which was referred back to them at the March meeting of the Council (see *ante* p. 547); and although there was a larger attendance of members on this occasion than when the Committee previously discussed the matter, the resolution was passed unanimously. At Wednesday's meeting of the Council, an effort was again made to refer the question back; but it failed, and the minutes were confirmed.

The Rivington Water-Works of the Liverpool Corporation.—A party of members of the Liverpool Engineering Society paid a visit to the Rivington water-works of the Liverpool Corporation last Saturday week; and they were accompanied over the works by Mr. R. T. Martin, the Resident Engineer. Proceeding to Chorley, the company drove the full length of the works from Heapey to Horwich, a distance of several miles; halts being made to view the most important engineering features. The following information was furnished: The various reservoirs, &c., have an aggregate area of 615 acres, and contain 4107 million gallons of water, and the works are completed by filter-beds, the area of which is more than 5 acres. The Upper Roddlesworth reservoir is 38 acres in extent; the greatest depth of water being 64 feet; and the total contents, about 180 million gallons. The Lower Roddlesworth reservoir is 16¾ acres in extent; the greatest depth of water is 78 feet; and the total capacity, about 100 million gallons. The Rake reservoir is 14 acres in extent; the greatest depth of water being 78 feet; and the capacity, 80 million gallons. The Anglezark reservoir is 197 acres in extent; and the total contents about 1019 million gallons. The two Rivington reservoirs cover 275 acres, and will hold 1841 million gallons; the greatest depth being 40 feet. The Chorley reservoir covers 10 acres, and contains 48 million gallons; the greatest depth being 39 feet. The Yarrow reservoir is 65 acres in extent, and has a capacity of 840 million gallons of water; the greatest depth being 93 feet. The filter-beds are six in number, each 309 feet long, 100 feet wide, and 10 feet deep.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 1309.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Price.	Rise or Fall in Wk.	Yield upon Invest.
£			p.c.	GAS COMPANIES.				£ s. d.
590,000	10	10 Apl.	10½	Alliance & Dublin 10 p. c.	10	21½–22½	..	4 13 4
100,000	10	,,	7½	Do. 7 p. c.	10	14½–15½	..	4 16 9
300,000	100	2 Jan.	5	Australian (Sydney) 5 % Deb.	100	105–107	..	4 13 4
200,000	5	10 May	6½	Bombay, Limited	5	6¾–7¼	..	4 9 8
40,000	5	,,	6½	Do. New	4	4¾–5¼	..	4 19 2
380,000	Stck.	28 Feb.	11½	Brentford Consolidated	100	247–252	+2	4 11 4
180,000	,,	,,	8½	Do. New	100	197–202	+2	4 4 2
220,000	Stck.	14 Mar.	11	Brighton & Hove Original	100	220–225	..	4 17 9
888,500	Stck.	28 Feb.	5	Bristol	100	122–125	+2	4 0 0
320,000	20	28 Mar.	11½	British	20	52–53	..	4 4 10
50,000	10	14 Mar.	11½	Bromley, Ordinary 10 p. c.	10	22–23	..	5 0 0
51,510	10	,,	8½	Do. 7 p. c.	10	17–18	..	4 14 5
328,750	10	12 June	4	Buenos Ayres (New) Limited	10	7½–7⅝	..	5 3 2
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	100	100–103	..	5 16 7
150,000	20	28 Feb.	8½	Cagliari, Limited	20	26½–27½	..	6 0 0
550,000	Stck.	10 Apl.	13½	Commercial, Old Stock	100	290–295	..	4 11 6
165,000	,,	,,	10½	Do. New do.	100	214–219	..	4 15 10
160,762	,,	12 June	4½	Do. 4½ p. c. Deb. do.	100	137–142*	+1½	3 3 4
800,000	Stck.	12 June	13	Continental Union, Limited.	100	250–255*	+3	5 1 11
200,000	,,	,,	10	Do. 7 p. c. Pref.	100	203–208*	+1½	4 16 2
535,000	Stck.	28 Feb.	5¼	Crystal Palace Ord. 5 p. c. Stk	100	122–127	..	4 2 8
486,090	10	31 Jan.	11	European, Limited	10	24–25	..	4 8 0
354,060	10	,,	11	Do. Partly pa d	7½	17–18	..	4 11 9
5,646,590	Stck.	14 Feb.	12	Gaslight & Coke, A, Ordinary	100†	273–278	−1	4 6 4
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	105–110	..	3 12 9
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	277–282	..	3 10 10
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	130–135	..	3 14 1
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	197–202	..	3 14 3
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	188–193	..	3 12 6
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	277–282	..	3 10 10
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	100	165–170	..	3 10 7
1,061,150	,,	12 June	4	Do. 4 p. c. Deb. Stk.	100	128–131*	+1	3 1 0
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	140–145*	+2½	3 2 1
908,000	,,	,,	6	Do. 6 p. c. do.	100	187–190*	+1	3 3 2
3,800,000	Stck.	10 May	12	Imperial Continental	100	247–252	+2	4 15 3
75,000	5	13 Dec.	6	Malta & Mediterranean, Ltd.	5	5¾–6¼	..	4 16 0
560,000	100	1 Apl.	5	Met. of Melbourne, 5 p.c. Deb.	100	112–114	+2	4 7 9
541,920	20	12 June	5	Monte Video, Limited	20	15½–16½*	+½	5 1 2
150,000	5	21 May	8	Oriental, Limited	5	7–7¼	..	5 6 8
60,000	5	28 Mar.	7	Ottoman, Limited	5	4¾–5¼	..	6 13 4
166,870	10	14 Feb.	2	Para, Limited	10	1¾–2¼	..	8 0 0
				People's Gas of Chicago—				
420,000	100	2 May	6	1st Mtg. Bds.	100	102–106	..	5 13 2
500,000	100	4 June	6	2nd Do.	100	100–105	..	5 14 3
150,000	10	26 Apl.	7	San Paulo, Limited	10	8½–9¼	..	7 7 4
500,000	Stck.	14 Feb.	15½	South Metropolitan, A Stock	100	350–360	..	4 6 1
1,350,000	,,	,,	12	Do. B do.	100	295–300	..	4 0 0
290,000	,,	,,	13	Do. C do.	100	307–312	..	4 3 4
775,000	,,	16 Jan.	5	Do. 5 p. c. Deb. Stk.	100	168–173	..	2 17 10
60,000	Stck.	28 Feb.	11½	Tottenham & Edm'nton, "A"	100	230–235	..	4 17 10
				WATER COMPANIES.				
746,021	Stck.	28 Dec.	10⅝	Chelsea, Ordinary	100	285–295	+7½	3 8 8
1,719,514	Stck.	10 Apl.	8	East London, Ordinary	100	228–23	+9	3 8 9
654,740	,,	28 Dec.	4½	Do. 4½ p. c. Deb. Stk.	100	151–156	..	2 17 8
700,000	50	13 Dec.	7†	Grand Junction	50	112–115	+5	3 0 10
708,000	Stck.	14 Feb.	12	Kent	100	307–312	+3	3 16 11
1,043,800	100	28 Dec.	7½†	Lambeth, 10 p. c. max.	100	250–260	+20	2 17 8
406,200	100	,,	7½	Do. 7½ p. c. max.	100	200–210	+2½	3 11 5
330,000	Stck.	28 Mar.	4	Do. 4 p. c. Deb. Stk.	100	136–140	..	2 17 2
500,000	100	14 Feb.	12½	New River, New Shares	100	360–370	+10	3 8 11
1,000,000	Stck.	31 Jan.	4	Do. 4 p. c. Deb. Stk.	100	142–144	+1½	2 15 7
902,300	Stck.	12 June	4	S'thwk & V'xhall, 10 p.c. max.	100	150–160*	‡	2 10 0
126,500	100	,,	4	Do. D 7½ p.c. do.	100	135–140*	+1	2 17 2
1,155,066	Stck.	12 June	10	West Middlesex	100	275–285*	+9	3 10 2

*Ex div.

† Next dividend will be at this rate. ‡ +12½

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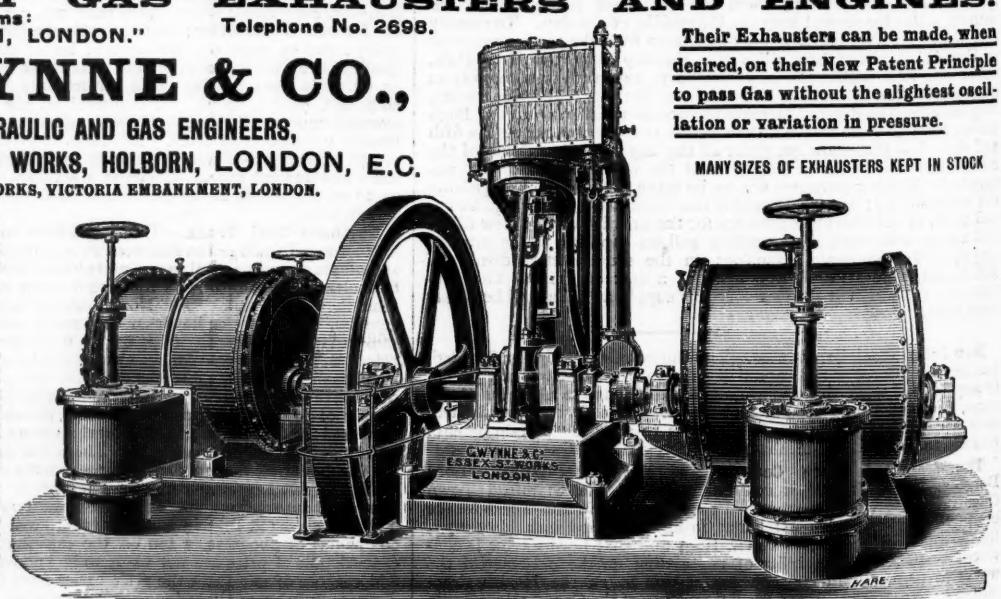

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By order,
R. VINCENT,
Clerk to the Council.

Town Hall, Leyton,
June 13, 1895.

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THE Undersigned is in a position to supply, at the very lowest Prices, the most suitable kind of BENZOL for enriching Gas, made from Hardman's Patent Carbonization Process, of which I am the Sole Patentee. On application, I would furnish Price on the most reasonable terms; giving advice how to utilize it on the most economical method.
J. HARDMAN, Manufacturing Chemist.
Milton, Staffs.

BACK-PRESSURE IN PURIFIERS.

THE Valve invented by Mr. Cripps for Bye-Passing any Layer of Purifying Material (referred to by the President of the Incorporated Institution of Gas Engineers in his Inaugural Address) can be obtained of the Makers: C. & W. WALKER, Midland Iron-Works, Donnington, near Newport, SALOP, and J. EVERY & SON, Phœnix Iron-Works, LEWES, to which Firms all inquiries should be addressed.

In Paper Covers, Post Free 2s.

STEPHEN CARPENTER, of the Bow Common Gas-Works, on the Purification of Coal Gas by Lime, Oxide of Iron, and Atmospheric Air, and the Method of Working Purifiers so that the Lime may be used a second time, with a description of Carpenter's short Method of working off the Sulphur Test and Table for calculating Results.
S. & H. W. CARPENTER, 3, Bedford Villas, Carshalton, SURREY.

GAS TAR Wanted.
TAR DISTILLERY "PERSEVERANTIA," LIMITED, Harlingen, HOLLAND.

GAS 5-feet Testing Holder Wanted. Second Hand; complete. State Price.
Address the NATIONAL METER COMPANY, LIMITED, Aquinas Street, STAMFORD STREET, S.E.

PHOTOMETER for Sale cheap, with Lighting Box, Micrometer Tap, Balance Governor, King's Gauge, and Clock Meter.
Apply to I. H. S., 32, CRAVEN STREET, W.C.

BRIERLEY HILL GAS COMPANY.

TENDERS FOR TAR.

THE Directors of the above Company are prepared to receive TENDERS for the surplus TAR made at their Brierley Hill and Kingswinford Works for One Year ending the 30th of June, 1896, delivered into Boats at the former place in one hour and at the latter in twelve hours.
Tenders to be addressed to the Chairman, and delivered not later than the 4th of July next.
The Directors do not bind themselves to accept the highest or any tender.

HENRY M. JACKSON,
Secretary.

Gas-Works, Brierley Hill,
June 10, 1895.

BRIERLEY HILL GAS COMPANY.

TENDERS FOR AMMONIACAL LIQUOR.

THE Directors of the above Company are prepared to receive TENDERS for AMMONIACAL LIQUOR made at their Brierley Hill and Kingswinford Works for a period of One or more Years, commencing the 1st of August, 1895.
Tenders to be addressed to the Chairman not later than the 4th of July next.
The Directors do not bind themselves to accept the highest or any tender.

HENRY M. JACKSON,
Secretary.

Gas-Works, Brierley Hil',
June 10, 1895.

WARE GASLIGHT AND COAL AND COKE COMPANY, LIMITED.

COAL SUPPLY.

THE Directors of the above Company invite TENDERS for the supply of from 900 to 1200 Tons of EAST PONTOP, NEW PELTON, or PELAW MAIN GAS COALS, to be considered at their Meeting to be held on Tuesday, the 18th day of June inst.

Full Particulars may be obtained on application to me the undersigned at my Office.

Dated this 4th day of June, 1895.

GEO. H. GISBY,
Secretary to the Company.

Baldock Street, Ware.

RAMSBOTTOM GAS COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of about 5000 Tons of COAL, to be delivered as required at their Works, Stubbins, near Ramsbottom.

Forms of Tender and full Particulars may be obtained on application to the undersigned.

Sealed tenders, endorsed, and addressed to the Chairman of the Company, must be sent in by Friday, July 5, 1895.

The Directors do not bind themselves to accept the lowest or any tender.

JOS. C. INGHAM,
Manager.

Gas-Works, Ramsbottom,
June 15, 1895.

TENDERS FOR GAS COAL.

THE Directors of the Chelmsford Gas-light and Coke Company invite TENDERS for the supply of about 3500 Tons of GAS COAL for delivery over the Year ending July 31, 1896.

Sealed tenders, endorsed "Tender for Coal," must be delivered at the Office of the Company not later than the 25th of June next.

The Directors reserve to themselves the right to decline the lowest or any tender.

Further Particulars and Forms of Tender to be obtained of the undersigned on application.

By order,
E. G. SMITHARD,
Engineer.

Gas-Works, Chelmsford,
June 8, 1895.

BOROUGH OF BRIGHOUSE.

TO IRONFOUNDERS.

THE Gas Committee of the Corporation invite TENDERS for the making and fixing of Two CAST-IRON PURIFIERS for the SULPHATE PLANT at their Mill Lane Station.

Plan and Specification can be seen, and Form of Tender obtained, on application to the Engineer.

Sealed tenders are to be sent in, addressed to the Town Clerk, Public Offices, Brighouse, on or before Tuesday, the 2nd day of July, 1895, endorsed on the outside "Tender for Purifiers."

The lowest or any tender not necessarily accepted.

By order,
JAMES PARKINSON,
Town Clerk.

Public Offices, Brighouse,
June 14, 1895.

BOROUGH OF BRIGHOUSE.

TO PAINTERS.

THE Gas Committee of the Brighouse Corporation invite TENDERS for PAINTING the THREE-LIFT TELESCOPE GASHOLDER, 120 feet diameter by 24 feet deep each Lift, and WROUGHT-IRON ANNULAR TANK, at their Mill Lane Station.

Specification can be seen, and Form of Tender obtained, on application to the Engineer.

Sealed tenders, endorsed on the outside "Tender for Painting Gasholder," to be sent in to the undersigned, Public Offices, Brighouse, on or before Friday, the 21st day of June, 1895.

The lowest or any tender not necessarily accepted.

By order,
JAMES PARKINSON,
Town Clerk.

Public Offices, Brighouse,
June 12, 1895.

COUNTY BOROUGH OF SALFORD.
(GAS DEPARTMENT.)

GENERAL STORES.

THE Corporation are prepared to receive TENDERS for the following MATERIAL, in such quantities as may be required, during the Twelve Months following the acceptance of the tender, viz.—

1. Iron.
2. Tin Sheets, Galvanized Piping, &c.
3. Lead Pipe, Block Tin Tubing, &c.
4. Bolts, Nuts, Rivets, &c.
5. Iron Castings, Cast-Iron Pipes, Irregulars, &c.
6. Brass Meter Taps and Keys.
7. Wrought-Iron Steam & Gas Tubes & Fittings.
8. Gas-Meters.
9. Paints.
10. Chandlery.
11. Oils, Tallow, &c.
12. Cotton Waste.
13. India-rubber Rings, Sheeting, &c.
14. Cement and Lias Lime.
15. Timber.
16. Rope, Yarn, &c.
17. Steel Shovels, &c.
18. Brushes.
19. Testing and Repairs of Weighing-Machines.
20. Phosphor Bronze and Gun Metal Fittings for Meters.

Forms of Tender and all Information may be obtained, and samples seen on application, to the Gas Engineer, Gas Offices, Bloom Street, Salford.

Sealed tenders (endorsed "Miscellaneous Goods"), addressed to the Chairman of the Gas Committee, must be delivered to me not later than Five p.m., on Thursday, the 4th of July.

By order,
SAML. BROWN,
Town Clerk.

Town Hall, Salford,
June 13, 1895.

HAWORTH URBAN DISTRICT COUNCIL.

TENDERS are invited for the purchase of the Council's surplus TAR and LIQUOR for the Year ending June 30, 1896, delivered on Rails at Haworth Station.

Tenders to be sent to me not later than June 27.

WM. ROBERTSHAW,
Clerk.

5, Temple Street, Keighley.

HORLEY DISTRICT GAS COMPANY, LIMITED.

THE Directors invite Tenders for the purchase of the surplus TAR and AMMONIACAL LIQUOR produced at their Works during the Year ending June 30, 1896, loaded into Tank-Waggons on Railway Siding at the Works.

By order,
RICHARD SANDELL,
Secretary.

3, Jeffreys Square, London, E.C.,
June 17, 1895.

GREAT WIGSTON GAS COMPANY.

TENDERS FOR COAL.

THE Directors are prepared to receive TENDERS for the supply of 1500 to 2500 Tons of best screened GAS COAL for the Year ending July 31, 1896.

Particulars and Forms of Tender can be had on application to the Manager.

Sealed tenders must be delivered not later than Monday, July 1, to A. A. Cooper, Esq., Chairman.

JOHN A. HARRIS,
Manager.

WAKEFIELD GASLIGHT COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the Wakefield Gas-light Company are prepared to receive TENDERS for the supply of GAS COAL and NUTS (about 25,000 Tons per Annum) for One, Two, or Three Years ending June 30.

Particulars and Forms of Tender can be obtained on application to the undersigned.

Tenders, endorsed "Tender for Coal," to be addressed to W. Statter, Esq., Chairman, and delivered not later than Saturday, June 29.

The Directors do not bind themselves to accept the lowest or any tender.

By order,
H. TOWNSEND,
Manager.

Gas-Works, Wakefield,
June 13, 1895.

LEEK URBAN DISTRICT COUNCIL.

TO TAR DISTILLERS AND OTHERS.

TENDERS are invited for the purchase of the surplus GAS TAR produced at the Leek Gas-Works for One, Two, or Three Years from the 1st of July, 1895, at per ton of 2240 lbs. at such Works.

Endorsed tenders, addressed to the Chairman of the Gas Committee, to be delivered at the Town Hall, Leek, by Four o'clock in the Afternoon of Friday, the 28th of June inst.

Forms of Tender and further Particulars may be obtained from the undersigned.

The highest or any tender will not necessarily be accepted.

By order of the Council,
C. HENSHAW,
Clerk.

Town Hall, Leek,
June 14, 1895.

SOWERBY BRIDGE URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

THE Gas Committee of the Sowerby Bridge Urban District Council are prepared to receive TENDERS for the supply and erection of an INNER or THIRD LIFT to a TWO-LIFT GASHOLDER at the Gas-Works, Sowerby Bridge.

Plans and Specifications may be seen, and further Particulars obtained, on application to Mr. John Marsland, Engineer and Manager, Gas-Works, Sowerby Bridge.

The Gas Committee do not bind themselves to accept the lowest or any tender.

Tenders must be sent in not later than Monday, June 24, 1895, endorsed "Tender for Third Lift to No. 3 Gasholder," addressed to

GODFREY RHODES AND EVANS,
Clerks to the Council.

Commercial Bank Chambers, Halifax,
June 13, 1895.

TENDERS FOR GAS COAL.

THE Gas Committee of the Town Com-missioners of Newry invite TENDERS for the supply of from 3000 to 3600 Tons of GAS COAL, to be delivered in such quantities as may be required by the Committee, and delivered free *ex* Ship or Steamer at Albert Basin, Newry.

The Coal to be fresh wrought, dry, and free from Clench, Pyrites, or other objectionable matter for Gas Making.

The Committee would assist the Contractor by allowing him to deliver about 1000 Tons of Coal prior to the 1st of November next.

Further Particulars may be obtained from Mr. A. Gibb, Manager.

Sealed tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal, and where raised, to be addressed to the Chairman, and delivered to the undersigned not later than Ten a.m., on Friday, the 28th inst.

The Committee reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender.

By order,
R. H. DOHERTY,
Town Clerk.

New Town Hall, Newry,
June 7, 1895.

TO COAL CONTRACTORS AND OTHERS.

THE Sedgley Urban District Council in-vite TENDERS for supplying 500 to 750 Tons of GAS COAL; the deliveries to be at Shut-End Siding, at such times and in such quantities as may be directed.

Sealed tenders, marked "Gas Coal," to reach me on or before the 3rd of July next.

The Council do not bind themselves to accept the lowest or any tender.

JOSEPH SMITH,
Clerk.

Offices: High Holborn, Sedgley,
June 12, 1895.

RHYL URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Gas Committee of the Rhyl Urban District Council invite TENDERS for the supply of 3000 Tons of screened GAS COAL, to be delivered during a period commencing the 1st of July, 1895, and terminating the 30th of June, 1896.

Further Particulars and Forms of Tender may be obtained from the undersigned.

Sealed and endorsed tenders, addressed to the Chairman of the Gas Committee, must be delivered on or before the 24th of June next.

The Committee do not bind themselves to accept the lowest or any tender.

LEONARD G. HALL,
Manager.

Gas Office, Rhyl,
June 8, 1895.

MORECAMBE GAS AND LIGHT COMPANY.

TENDERS FOR COAL.

THE Directors of the above Company are prepared to receive TENDERS for the supply of 3000 Tons per Annum of screened GAS COAL, to be delivered on the Gas-Works Siding, Midland Railway, Morecambe, in such quantities as may be required, during a period of One, Two, or Three Years.

Tenders, specifying the description of Coal, the name of the Pit at which it is raised, and the Terms for net monthly payments, are to be sent in on or before Saturday, the 22nd of June, 1895, endorsed "Tender for Coal."

The Directors do not bind themselves to accept the lowest or any tender.

WILLIAM DUFF,
Secretary and Manager.

Market Street, Morecambe,
June 1, 1895.

SHREWSBURY GASLIGHT COMPANY.

TENDERS FOR COAL.

THE Directors of the Shrewsbury Gas-light Company invite TENDERS for the supply of about 12,800 Tons of Screened GAS COALS, and about 700 Tons of good English CANNEL, to be delivered free at the Great Western or London and North-Western Goods Yard, Shrewsbury, during One, Two, or Three Years, commencing July 1, 1895.

The Directors reserve to themselves the right to divide the quantity into two or more Contracts, and do not bind themselves to accept the lowest or any tender.

Tenders must be made on Forms (containing further particulars) which may be obtained on application at the Company's Works, or by post, and must be sent to the undersigned, on or before the 22nd day of June, 1895

By order,
WM. BELTON, Assoc.M.Inst.C.E.,
Secretary and Manager.

Gas-Works, Shrewsbury,
May 20, 1895.

TIPTON GAS-WORKS.

COAL CONTRACTS.

THE Gas Committee of the Tipton Urban District Council are prepared to receive TENDERS for the supply of GAS COAL for a period of One, Two, or Three Years, from the 1st of July next; to be delivered, carriage free, to the Gas-Works Siding (L. & N.W. Railway).

Specification and Form of Tender may be obtained at the Gas-Works, on application to Mr. Vincent Hughes, the Engineer and Manager.

Sealed and endorsed tenders to be sent to me the undersigned not later than Ten a.m., on Saturday, the 22nd inst.

The Committee do not bind themselves to accept the lowest or any tender.

By order,
GEO. M. WARING,
Clerk to the Council.

Public Offices, Tipton,
June 4, 1895.

COMMERCIAL GAS COMPANY.

TENDERS FOR COAL.

THE Directors are prepared to receive TENDERS for the supply of 190,000 Tons of clean, dry, unscreened, fresh-wrought GAS COALS, delivered f.o.b. to the Company's Steamers at any suitable Port, during the Year ending the 31st of July, 1896.

The deliveries to be in equal monthly quantities throughout the Year.

Payment in cash monthly.

Parties desiring to tender for more than One Year must state separately the price and quantity offered for each Year.

Particulars and Forms of Contract may be obtained from the Engineer, Mr. H. E. Jones.

The Directors do not bind themselves to accept the lowest or any tender.

Tenders, sealed and endorsed "Tender for Coals," to be addressed to the Chairman of the Coal Committee, and delivered at the Company's Offices not later than Twelve o'clock on the 19th of June, 1895.

Commercial Gas-Works, Stepney, E.,
May 30, 1895.

THE East Dereham Urban District Council are prepared to receive TENDERS for the supply of about 1200 Tons of screened GAS COAL for the ensuing Year.

Conditions and Forms of Tender may be had of the undersigned.

Tenders to be sent in by the 2nd of July, 1895.

B. H. VORES,
Clerk to the Urban District Council.

East Dereham.

COLNE URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the supply of GAS COAL for One Year from the 1st day of August next.

Particulars and Form of Tender may be obtained from the undersigned, to whom the tenders must be delivered on or before the 17th day of June.

The Committee do not bind themselves to accept the lowest or any tender.

(Signed) HY. SIMMONDS,
Engineer and Manager.

Gas-Works, Colne,
June 1, 1895.

URBAN DISTRICT COUNCIL OF LYMM.

THE above Council invite Tenders for a STEEL CORNISH BOILER, 14 feet long, by 5 ft. 6 in. diameter, with all necessary Mountings complete.

Specification and any further Particulars required may be had on application to the undersigned.

Sealed tenders, endorsed "Boiler," to be sent in to W. Mullard, Esq., Clerk to the Council, on or before the 27th day of June, 1895.

The Council do not bind themselves to accept the lowest or any tender.

WILLIAM SEVERS,
Gas Manager.

Lymm, Cheshire,
June 15, 1895.

DUKINFIELD URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

TENDERS FOR TAR.

THE Gas Committee of the above Council invite TENDERS for the TAR produced at the Works for the Year commencing the 1st of July next.

The quantity made is about 400 Tons, and will be delivered free into Boats on the Canal, or in Barrels at the Works.

Tenders, endorsed "Tar," to be here by Saturday, the 22nd inst.

HARRISON VEEVERS, C.E.,
Engineer and Secretary

King Street, Dukinfield,
June 6, 1895.

BOROUGH OF DARWEN.

COAL AND CANNEL.

THE Corporation are prepared to receive TENDERS for the supply of 12,500 Tons of COAL and 1500 Tons of CANNEL, to be delivered at the Gas-Works Railway Siding during the ensuing Twelve Months.

Forms of Tender and any further Particulars required can be obtained from the Manager, Mr. A. E. Smith, Charles Street, Darwen.

Tenders to be addressed to the undersigned, endorsed "Coal" or "Cannel," and delivered at my Office, by Ten a.m., on Monday, the 24th of June.

No tender necessarily accepted.

By order,
CHAS. COSTEKER,
Town Clerk.

Town Clerk's Office, Darwen.

BOROUGH OF DONCASTER.

TENDERS FOR COALS.

THE Gas Committee of the Borough of Doncaster are prepared to receive TENDERS for the supply of 14,000 Tons of best GAS COAL during a period commencing July, 1895, and terminating June 30, 1896.

Particulars and Tender Forms may be obtained on application to John Athron, Esq., Chairman, or to the undersigned.

Tenders should be sent, under seal, to the Chairman, endorsed "Tender for Coal," not later than Ten a.m., on Wednesday, the 10th of July next.

By order of the Gas Committee, who do not bind themselves to accept the lowest or any tender.

RT. BRIDGE,
Engineer.

Gas-Works, Doncaster,
June 6, 1895.

COUNTY BOROUGH OF BRADFORD.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas and Electricity Supply Com- mittee of the Bradford Corporation are prepared to receive TENDERS for the supply of best GAS COAL, COBBLES, NUTS, and CANNEL, all to be well-screened, dressed, and free from Shale and Pyrites, to be delivered at the several Works of the Corporation in the Borough during the period of One Year or of Two Years, commencing on the 1st day of August next, as may be agreed upon.

Form of Tender, with any further Information required, may be had on application to Mr. Wood, Gas Engineer, Town Hall.

Sealed tenders, endorsed "Tender for Coal," to be sent to me on or before Wednesday, the 3rd of July next.

An assurance must be given by each Contractor that he pays to the workmen employed by him not less than the minimum standard rate of wages.

The Committee do not bind themselves to accept the lowest or any tender.

By order,
W. T. M'GOWEN,
Town Clerk.

own Hall, Bradford,
J ne 7, 1895.

HORNSEY GAS COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS, so far as they relate to DEBENTURE STOCK only, WILL BE CLOSED on the 22nd inst., and RE-OPENED on the 2nd of July, 1895.

S. J. WILLIAMS,
Secretary.

Chief Offices: 68, Chancery Lane, W.C.,
June 11, 1895.

WANDSWORTH AND PUTNEY GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of the Company, so far as the DEBENTURE STOCK only is concerned, WILL BE CLOSED on and from the 25th of June, 1895, to the 3rd of July, 1895, both days inclusive.

By order,
H. S. FREEMAN,
Engineer and General Manager.

Offices: North Street, Wandsworth,
June 13, 1895.

TOTTENHAM AND EDMONTON GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company so far as they relate to the DEBENTURE STOCK WILL BE CLOSED at Ten o'clock forenoon on Friday, the 14th inst., and will be re-opened on Friday, the 28th inst.

The Interest for the Half Year to the 30th of June, 1895, will be payable on the 1st day of July next to the Proprietors registered on the closing of the Books.

By order of the Board,
JAMES RANDALL,
Secretary.

Gas Offices, Willoughby Lane,
Tottenham, June 7, 1895.

By order of the Directors of the Lea Bridge District Gas Company, £4000 4 per cent. PERPETUAL DEBENTURE STOCK of this Company, to be created and issued under the Provisions of the Lea Bridge District Gas Act, 1878, and offering to Trustees and others an Investment of the highest class, for Sale by Auction by

MR. ALFRED RICHARDS, at the Mart, E.C., on Thursday, June 20, at Two o'clock precisely in lots.

Particulars of the SECRETARY of the Company, 3, JEFFREYS SQUARE, E.C.; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

TO GAS MANAGERS, COAL MERCHANTS, INVESTORS, AND OTHERS.

BURGH-LE-MARSH, LINCOLNSHIRE.

SALE OF GAS-WORKS.

TO BE SOLD, by Auction, by Messrs. JOHN WILLSON & SON (by order of the Mortgagees), at the Bell Hotel, Burgh-le-Marsh, on Thursday, the 4th day of July, 1895, at 2.30 o'clock in the Afternoon precisely, subject to such Conditions of Sale as will be then and there produced, the under-mentioned very valuable Freehold Estate, namely—

All that substantially built COTTAGE or TENEMENT, with the GAS-HOUSE, WORKSHOP, and LIME-SHED, PURIFYING-HOUSE, RETORT-HOUSE, COAL-SHED, and other OUTBUILDINGS, YARD and GARDEN thereto adjoining and belonging, together with the GAS-WORKS PLANT and other FIXTURES upon the said Premises, and the MAIN PIPES and GAS-METERS appertaining thereto.

The above Premises are situate at Burgh-in-the-Marsh aforesaid, and contain, by admeasurement, One Rood (or thereabouts), and are bounded by the Public Highway on the North and East, by lands of the Trustees of the late Mr. John Dawson on the West, and by lands now or late of Mr. James Falkinder on the South, and are now in the occupation of Mr. Thomas Pool.

The above Premises are well situated and commodious. Size of Gasholder, 24 feet by 12 feet, holding about 6000 feet of Gas. There is a good Tire Pump in the Workshop. The Purifying-Shed includes two Purifiers, both 4 ft. 8 in. by 2 ft. 6 in., depth 2 ft. 6 in. There is a set of Condensers of 5-inch Pipes.

The Retort-House contains One Bed or Setting of two Retorts. Size of Retorts, 15 inches by 13 inches, and 8 feet in length.

The Coal-Shed will hold 50 Tons of Coal; and a nice Coal Trade can be done.

There are Sixteen Public Lamps (one a Bracket and the rest Standard Lamps).

Mains and Service Pipes included.

This Property is altogether a very desirable one, and affords an excellent Investment for any purchaser.

To view, apply to the said Thomas Pool, or to us the undersigned; and for further Particulars to the Auctioneers, Hogsthorpe, near Alford, or at the Offices of

WALKER, SONS, AND RAINEY,
Solicitors,
Spilsby and Alford.

Spilsby, June 13, 1895.

NOTICE.

TO GAS ENGINEERS AND OTHERS.

MESSRS. CLAPHAM BROS., Limited, Keighley, Yorkshire, are no longer authorized to Manufacture my CONDENSER and WASHER-SCRUBBERS.

The above-named Gas Apparatus are erected and giving entire satisfaction at the following places: Neath, Lincoln, Sheffield, Ellesmere, Mountain Ash, Malden, Cullingworth, Montreal (Canada), Woodstock (South Africa), Cape Town (South Africa), &c.

These Appliances can now be obtained solely of the undersigned.

Winchester House, London, E.C. J. A. KELMAN.

In Paper Cover, Price 1s.

GASHOLDERS
WITH OR WITHOUT
GUIDE-FRAMING.

A Discussion between E. LLOYD PEASE and F. SOUTHWELL CRIPPS.

To which is added a Synopsis of

LITERATURE ON GASHOLDER CONSTRUCTION,

Containing references to all the Literature (English and Foreign) on Reducing or Abolishing the Guide-Framing of Gasholders, also the principal Literature on Gasholder Construction generally, compiled to March, 1893; with a List of all the English and Foreign Periodicals connected with the Gas Industry.

COMPILED BY

F. SOUTHWELL CRIPPS,

Associate Member of the Institution of Civil Engineers; Fellow of the Imperial Institute; Member of the Institution of Gas Engineers; Member of the Society of Arts;

AUTHOR OF

"The Guide-Framing of Gasholders and Strains in Structures Connected with Gas-Works;"
"The Flow of Gases and Proportioning Gas-Mains," &c.

LONDON: Walter King, 11, Bolt Court, Fleet St., E.C.

"BEAR CREEK" CANNEL.

LOG MOUNTAIN COAL, COKE, AND TIMBER CO.,
PINEVILLE, KENTUCKY, U.S.A.
Cable Address: "Hull, Pineville."

LONDON AGENTS:
W. J. WILSON & Co., Suffolk House, Cannon St., E.C

NOTICE.

The Incandescent Gas-Light Company, Limited, Hereby Give Notice, that they only supply their Mantles subject to the following express Conditions, which are printed and pasted on each box:—

"The Incandescent Gas-Light Company, Limited, in supplying the Mantle contained in this box, grant a Limited License to the purchaser to sell or use the same on the express condition that neither the purchaser nor any other person into whose hands the same may come shall use or sell the said Mantle except in connection, or for use, with Burners sold or supplied by the Company; any other sale or use will amount to Infringement of the Company's Patents. The Company supply Mantles for the purpose of renewals at the nominal price of 1s. 3d., subject to the Conditions and Limitations above set forth."

In the case of *The Incandescent Gas-Light Company, Limited v. Cantelo*, Mr. Justice Wills upheld the Validity of these Conditions and Limited License; and, in the course of his Judgment, said:—

"The patentee has the sole right of using and selling the articles; and he may prevent anybody from dealing with them at all. Inasmuch as he has the right to prevent people from using them or dealing in them at all, he has the right to do the lesser thing—that is to say, to impose his own conditions. It does not matter how unreasonable or how absurd the conditions are. It does not matter what they are if he says at the time when the purchaser proposes to buy, or the person proposes to take a license: 'Mind I only give you this license on this condition;' and the purchaser is free to leave it or take it as he likes. If he takes it, he must be bound by the condition."

In the case of *The Incandescent Gas-Light Company v. Hirschfeld and Others*, the Honourable Mr. Justice Romer certified that the Validity of the Plaintiffs' Patents was established. Infringers in future will be liable to costs as between Solicitor and Client.

(Signed) FAITHFULL & OWEN,
Solicitors for the Incandescent Gas-Light Company, Limited.

AUSTRALIAN BOGHEAD.

Practical Results in Ordinary Working:—

Gas per Ton . . 15,100 Cub. Ft.
Illuminating Power . 45·6 Candles.

For Samples and Prices, f.o.b. London or c.i.f. to Continental Ports, apply to

THOMAS RAISON & Co.,
117, LEADENHALL STREET, E.C.

TO EMPLOYERS, COMPANY DIRECTORS, ETC.

The LAW GUARANTEE & TRUST SOCIETY, LIMITED,
GUARANTEES FIDELITY.

Send for complete Prospectus, containing Balance-Sheet, Copy of Policy, &c., &c.

HEAD OFFICE:
49, CHANCERY LANE, LONDON, W.C.

COKE-BREAKERS,

PRICES REDUCED.

(THOMAS & SOMERVILLE'S PATENT.)

New Design, with two Cutting Rollers, making less Breeze than their old pattern.

GEORGE WALLER & CO.,
PARK STREET, SOUTHWARK, E.C.,
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NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

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NEWBATTLE COLLIERIES,
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HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS:—

Yield of Gas Per Ton. . 11,205 Cubic Feet.
Illuminating Power, 16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality) 13¾ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE, 2500 TONS.

RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton. . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . 13½ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar . . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 94½ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COALFIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

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BLACK BED GAS COAL.

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SULPHATE OF AMMONIA SATURATORS.

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Central Plumbing Works, Town Hall Square,
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Improved Lead-Burning Machines, Sulphate Bagging Machines, Copper Scoops, &c.

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WORKED BY THE

WEARDALE IRON & COAL Co. Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by
Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton . . 10,500 Cub. Ft.
Illuminating Power . . 16·9 Candles.
Coke (of good quality) . . 67·5 per Cent.
Sulphur . . . . . 0·58 ,,
Ash . . . . . 2 73 ,,

For Price, &c., apply to the

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QUAYSIDE, NEWCASTLE-ON-TYNE.

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ANALYSIS AND PRICES ON APPLICATION.

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GAS COAL.

YIELD OF GAS PER TON . 10,375 CUBIC FEET.
ILLUMINATING POWER . 17·50 SPERM CANDLES.
COKE . . . . . 75 PER CENT.

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A TRIAL IS RESPECTFULLY SOLICITED.

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FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,

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Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
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PIPES, 2-in. to 8-in. PIPES, 2-in. to 8-in. PIPES.

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BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.

Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton . . 10,500 Cubic Feet.
Illuminating Power . . 16·9 Candles.
Coke . . . . . 66·7 Coke.
Sulphur . . . . . 0·86 Sulphur.
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Boldon Gas Coals are supplied under contract to

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HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

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W. RICHARDSON, Fitter.

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TYNE
BOGHEAD CANNEL.

Yield of Gas per ton . . . . . 13,155 cub. ft.
Illuminating Power . . . . . 38·22 candles.
Coke per ton . . . . . 1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 73·1 per cent.

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Coal Owners, Newcastle-on-Tyne;
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Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
Shipments Promptly and Carefully Executed.

THE SILICA FIRE-BRICK COMPANY,

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MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY,
Strongly recommended where EXCESSIVE HEATS have to be maintained.

KENT'S THICK GAS COAL

RAISED AT
The Wharncliffe Woodmoor Colliery,
BARNSLEY.

Yield of Gas, nearly 12,000 *Cubic Feet per ton of Coal; and Illuminating Power nearly* 17½ *Candles.*

The following is a complete ANALYSIS made by Mr. R. O. PATERSON, C.E., Gas-Works, Cheltenham:—

Specific Gravity (Water 1). . 1·276
Weight of One Cubic Foot. . 79·700 lbs.

PROXIMATE ANALYSIS.

Moisture in Coal . . . . . 2·68 per cent.
Volatile Matter. . . . . 35·60 ,,
Fixed Carbon . . . . . 58·80 ,,
Sulphur . . . . . 0·96 ,,
Ash. . . . . 1·96 ,,

COMMERCIAL ANALYSIS.

Gas per Ton of Coal . . . . 11,760 cub. feet.
Gas per Cubic Foot of Coal . 418 ,,
Illuminating Power . . . . 17·44 candles.
Value of One Cubic Foot in Sperm . . . . . 418 grains.
Value per Ton of Coal in Sperm . . . . . 703 lbs.
Coke per Ton of Coal . . . 1367 ,,
Coke . . . . . 61·05 per cent.
Ash in Coke . . . . . 3·21 ,,
Sulphur Eliminated with Volatile Products per Ton of Coal 9·4 lbs.
Sulphur in Coke per Ton of Coal . . . . . 12 ,,
Ammoniacal Liquor per Ton of Coal . . . . . 19·7 galls.
Tar per Ton of Coal . . . . 12·2 ,,

R. O. PATERSON, C.E.
Gas-Works, Cheltenham, 8th August, 1894.

For Price, &c., apply to the
Wharncliffe Woodmoor Colliery Co LIMITED,
BARNSLEY;
Or to Mr. W. H. HARVEY,
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Superior to the very Volatile Hydrocarbons; requiring only a simple apparatus, at quite a nominal cost.

Coal Gas enriched by "CANNELINE" shows conclusively this Hydrocarbon is vastly superior to all other Enriching Agents, including Cannel Coal.

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SELF-SEALING MOUTHPIECES

Made strong for Horizontal and Inclined Retorts in Round, Oval, and Ω shapes, and to open at Right Angles for Machine Work. Faced in Ruscoe's Patented Machines; thus ensuring correct and smooth joints when closed.

TESTIMONIALS.

Sheffield United Gaslight Company, Commercial Street, Sheffield, 11th April, 1895.

DEAR SIR,—In reply to your enquiry, I have pleasure in saying that we have a number of your Retort Mouthpieces at work, and that they give perfect satisfaction. Yours faithfully,
FLETCHER W. STEVENSON,
Engineer.
Mr. JOHN RUSCOE.

Leigh Urban District Council, Gas & Water Departments, Leigh, Lancs., April 11th, 1895.

DEAR SIR,—In reply to yours of yesterday, I have pleasure in testifying that the Retort Mouthpieces which you supplied to the Leigh Gas-Works seven years ago have given every satisfaction. We have now 267 of the Mouthpieces erected, and hitherto none have required refacing. Yours faithfully,
A. T. FLETCHER.
Mr. J. RUSCOE, Albion Works, Hyde.

FOR PARTICULARS APPLY TO **JOHN RUSCOE, ALBION WORKS, HYDE.**

JOHN BROWN & CO., LTD., SHEFFIELD,

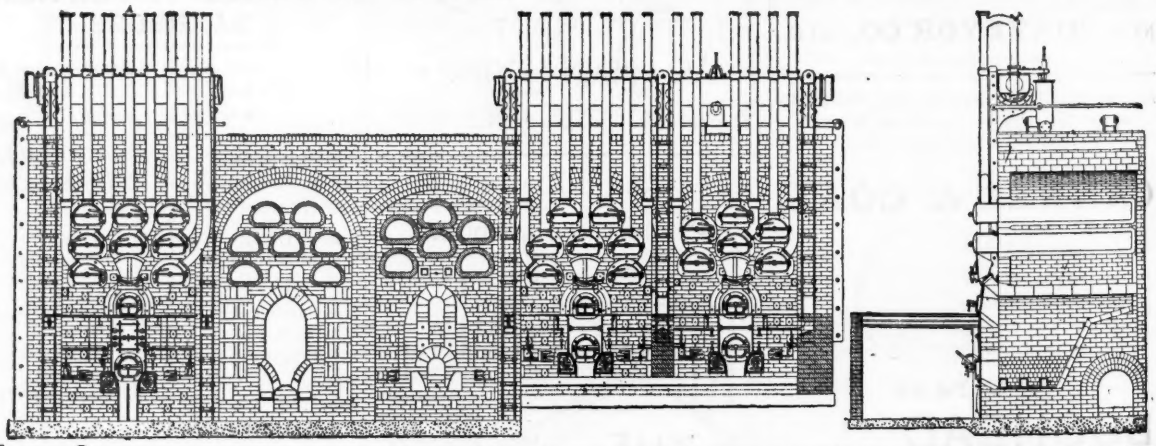
Proprietors of

ALDWARKE MAIN CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 feet of 19-candle gas per ton.
Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.
Telegrams: "ATLAS SHEFFIELD."

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS, CARBONIZING FROM 18 TO 24 CWT. OF ENGLISH AND 21 TO 26 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

Full Particulars may be had on application to the Patentee's Agents: **Messrs. JONAS DRAKE AND SON**, Retort Setters and General Carbonizing Engineers, Ovenden, Halifax, Yorkshire, Sole Agents for England, Wales, and Foreign Countries; **C. M. HAMILTON**, Retort Setter and Contractor, 5, Stuart Street, Shawlands, Glasgow, Agent for Scotland and Ireland; and to the Principal Agent, **R. F. HISLOP** (Son of Patentee), General Constructing and Carbonizing Engineer, Gas-Works, Paisley, N.B.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non* TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

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SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S Patents, all Spent Limes are effectively recovered at from one-third to one-half the cost of New Lime.
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The Great Reduction in Prices,

Due to Colossal Sales,

Places this highly popular Light within the means of all classes.

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The PRICES have been REDUCED as follows—

The Ordinary "C" Burner	**Price 10s. 6d.**
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Prices of other Patterns reduced proportionately.

SPECIAL ATTENTION IS CALLED TO

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Which, with a Consumption of 2¼ Cubic Feet of Gas an hour, gives a light of 25 to 30 Candle Power.

This Pattern is particularly recommended where it is desired to effect a large saving in Gas rather than to effect a great increase in the Light.

The attention of Gas Managers and Gas Engineers is called to this System of Lighting as one which tends to Popularize the use of Gas as an Illuminant, owing to the following Advantages—

ECONOMY IN CONSUMPTION OF GAS, COMBINED WITH HIGH ILLUMINATING EFFICIENCY.

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The *Lancet* Special Analytical and Sanitary Commission, in an exhaustive report, pronounces the Incandescent Gas-Light System to be the Healthiest, Best, and most Economical System of Gas Lighting.

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NETHAM CHEMICAL CO., Limited, BRISTOL.
ANIMAL CHARCOAL CO., Limited SHADWELL.
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Have during the past 2½ years constructed

CARBURETTED WATER-GAS PLANTS

Of the following daily capacities:—

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Belfast	1,700,000 ,,	Liverpool	2,500,000 ,,
Glasgow	300,000 ,,	Tottenham	600,000 ,,
Santiago	400,000 ,,		

And have now under Contract:—

Belfast (Second Contract)	3,500,000 Cub. Ft.	Southport	750,000 Cub. Ft.
Brighton	1,250,000 ,,	Manchester	3,000,000 ,,
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In addition to which the previous Installations of The Gaslight and Coke Company under this System have a total capacity of 10,000,000 cubic feet per diem.

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1 cwt. equals 3 cwt. of RED LEAD.
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Free from Resin.
Cheapest and Best.
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SUITABLE FOR GASWORKS OF ALL SIZES, AND FOR ANY CLIMATE
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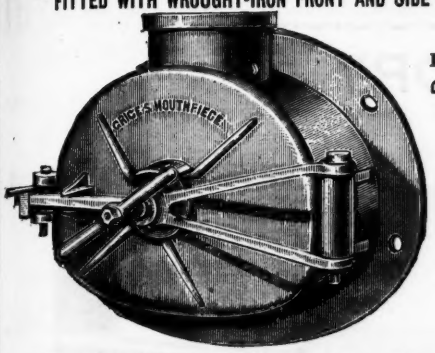

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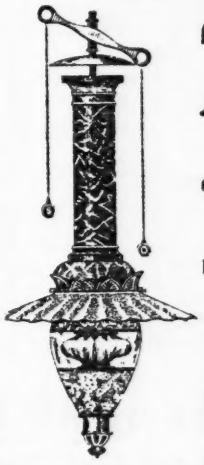

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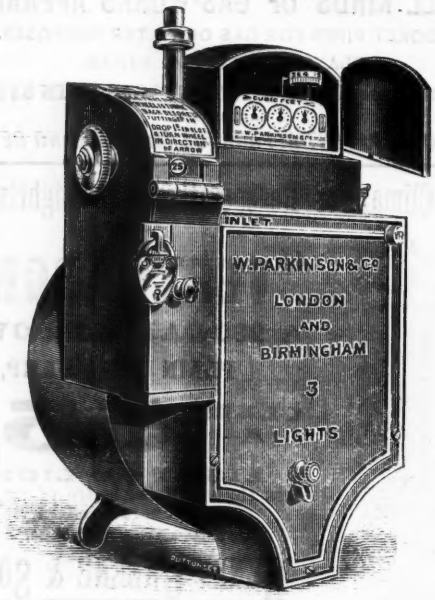

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[See also Advt. p. 1296.

LONDON: Printed by WALTER KING (at the Office of King, Sell, and Railton, Ltd., 12, Gough Square); and published by him at 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, June 18, 1895.